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LEVEL II

RADC-TR-80-341
Final Technical Report
November 1980

VINSON/AUTOVON INTERFACE APPLIQUE FOR THE MODEM, DIGITAL DATA, AN/GSC-38

Harris Corporation

Frank Perkins, et al
Salvatore J. Nasci (RADC)

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RADC-TR-80-341 has been reviewed and is approved for publication.

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The primary objective of this program was to provide a high quality, inexpensive secure voice terminal over commonly available transmission sources such as AUTOVON. A significant breakthrough achieved by RADC under the 16 KB Modem Program offers the potential of providing significantly improved secure voice service in the near term (1980-81). The breakthrough was achieved by interfacing the VINSON (an existing 16 KB Voice Digitizer/Crypto Device) with the RADC

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16 KB Modem to permit operation over dialed-up unconditioned AUTOVON telephone circuits. Six VINSON/16 KB Modem Terminals were fabricated, tested, and successfully demonstrated to the DoD Secure Voice Community. Demonstrations were presented to numerous General Officers and other high-level DoD officials at the Pentagon, Defense Communications Agency, Tactical Air Command, US Readiness Command, Strategic Air Command, North American Defense Command, Aerospace Defense Command, USAFE, USEUCOM, USNAVEUR, USNAVCAMSMED, AFSC/CC at "Horizon South-80" and at the tactical exercise "Gallant Eagle-80". All participants in the demonstrations were very impressed with the flexibility and excellent voice quality provided by the VINSON/16 KB Modem Secure Voice Terminal and they all support its use in improving the DoD Secure Voice System (AUTOSEVOCOM) and in satisfying their unique secure voice communications needs. Although the future AUTOSEVOCOM will primarily utilize the new digital transmission systems now being planned/deployed throughout the DCS, it will be many years before all of the existing analog transmission systems are replaced. Consequently, the VINSON/16 KB Modem Terminal provides the efficient means for transmitting secure voice over narrowband analog circuits.

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EVALUATION

The Department of Defense requirements for an improved, inexpensive, end-to-end secure voice communication system using the existing analog AUTOVON Network has fostered the investigation of various secure voice transmission approaches. One such approach considered is the 16 kbps Continuously Variable-Slope Delta Modulation (CVSD) digital voice technique which offers greatly improved speaker recognition and voice intelligibility as compared to that obtained with slower data rate digital voice systems presently available. This need for an improved secure voice system and, moreover, the requirement to use existing narrowband (4 kHz) voice channels of the AUTOVON Network for secure voice transmission have created the need for 16 kbps narrowband devices. One such device is the RADC developed 16 KBPS Modem. The modem, coupled with the VINSON (KY-58, 16 KB Voice Digitizer/Crypto device), plus an interface applique unit, makes up the total package that provides a high quality, inexpensive secure voice terminal.

This report covers the history of the modem's development, the design of the VINSON/AUTOVON Adapter and the demonstration conducted in the CONUS and in Europe. The demonstrations, presented to high level DoD officials throughout the CONUS and Europe, were very successful.

All participants in the demonstrations were very impressed with the flexibility and excellent voice quality provided by the VINSON/16 KB Modem Secure Voice Terminal. As a result of the successful demonstrations, the

Low-Rate-Initial-Production (LRIP), under Contract F30602-78-C-0273, has been increased from one hundred (100) Modem Digital Data, AN/GSC-38's to three hundred fifty (350) AN/GSC-38's with VINSON/AUTOVON Adapters.

SALVATORE J. NASCI
Project Engineer

1.0 INTRODUCTION

1.1 Background

The Harris Corporation, Government Systems Group (GSG), Melbourne, Florida was awarded a multiphased development contract by the Rome Air Development Center (RADC) on 8 August, 1978, to develop, through Low Rate Initial Production, a 16 KB/S wireline modem (AN/GSC-38). Subsequent to that award, and during the validation (Phase I) phase of the contract, RADC modified the contract in April, 1979, to include, in parallel, the feasibility development of a VINSON (KY-58)/AUTOVON Interface Applique (VINSON/AUTOVON Adapters) that would allow rapid placememt of secure calls on AUTOVON 2-wire and 4-wire circuits utilizing the 16 KB/S modem and VINSON COMSEC equipment.

The primary contract award, as well as the modification, followed three highly successful study contracts performed by Harris GSG for RADC.

Contract F30602-75-C-0129. Techniques study to develop practical 16 KB/S modem providing adequate voice quality over the AUTOVON system. The resulting breadboard modem was successfully tested over both AUTOVON and commercial telephone networks at both Harris GSG and RADC.

Contract F30602-76-C460. Extensive tests of the modem over the OCONUS AUTOVON in Hawaii, England, Germany, and Italy. Included tests over tropo, satellite and subcables with outstanding results. The modem sync reliability was greater than 97 percent over all calls. The median BER for all calls, including loops, was better than 2.4×10^{-3}.

Additionally, the modem was extensively tested at government installations throughout CONUS with very positive results.

Contract F30602-77-C-0190. Preliminary LSI partitioning study of basic modem design with the objective of production-oriented cost and size reduction. The study results were favorable; projected potential 30 per cent cost/size reduction if the modem were to be implemented with 2901A bit-slice microprocessors, with additional savings possible by incorporation of selected custom LSI.

1.2 Objective

The objective of the VINSON/AUTOVON Adapter modification to the contract was to demonstrate the feasibility and ability of the 16 KB/S modem, when used with existing VINSON COMSEC equipments, of providing near-term secure communications to selected AUTOVON subscribers for whom AUTOSEVOCOM Service was not available.

In addition, the following constraints were placed on the effort:

- The resulting system was to be capable of being operationally available within 1 year.

- There were to be no significant changes to the existing AUTOVON system, operation, or interfaces.

- Voice quality, ease of use, and interoperability with existing subscribers must be sufficient to ensure user acceptance.

- No major hardware development requirement; particularly in the COMSEC area.

- The resulting design was to consider, to the extent feasible, the architecture of the 16 KB/S modem under development.

Additional requirements were to perform initial field verification and demonstration of the resulting designs between selected government locations. Applicable portions of the hardware that transversed RED/BLACK interfaces were to be TEMPEST qualified in accordance with NACSEM 5100.

In addition to the objectives/requirements previously stated, Harris GSG was to deliver to RADC, at the completion of the program, six feasibility sets of equipment including modified GFE modems.

1.3 Approach

The program approach essentially involved several parallel efforts. The basic 16 KB/S modem design existed; however, the interface between the modems, COMSEC equipment, and AUTOVON system required definition and design. This design then required breadboarding and field verification in parallel with fabrication of the deliverable feasibility units.

1.3.1 Initial Design and Breadboard

The initial system design evolved after discussions with various agencies and commands including RADC, AFSS, C^3I, NSA, DCA, TAC, SAC, and REDCOM. The design was then implemented in a breadboard (nondeliverable) configuration with existing discrete implementation breadboard 16 KB/S modems. The inital complement included two GFE RADC breadboard modems and two Harris GSG breadboard modems. The applique equipment, discussed later in this report, was configured as breadboard also. The resulting breadboard VINSON/AUTOVON adapters, after in-plant integration and verification, were used for extensive field verification and demonstration between a variety of government locations.

1.3.2 Final Configurations

The final design was implemented in parallel with the initial breadboard effort. This effort required implementation of design changes resulting from field evaluations as well as formal TEMPEST testing. The final units were then completed, formally tested, and delivered to RADC. It should be noted that final design of these units did not take into consideration those factors normally associated with eventual production.

1.4 Results

All objectives were met and, in most cases, exceeded. Verification tests were performed in various combinations and configurations between the following locations using the AUTOVON network:

- MacDill AFB - REDCOM SECORD with and without KY-3 Terminals.
- The Pentagon - 758C Secure Switch and 2-wire and 4-wire interfaces.
- DCA Headquarters - 4-wire Interface.
- Langley AFB - TAC 2-wire Interface.
- OFFUTT AFB - SAC Radio Wire Integration (RWI) with Airborne Command Post.
- Scott AFB - AFCC-2-wire Interface.
- ADCOM - 2-wire Interface.
- Keesler AFB - 2-wire Interface.
- Harris Corporation - 2-wire and 4-wire Interfaces.

The test and verification effort was highly successful. Although minor problems were encountered with echo suppressors and marginal carrier systems at some locations, all tests were able to be performed. The modems used during the demonstrations were breadboards and, as such, exhibited an occasional reliability problem. One of the GFE KY-58's also exhibited a reliability problem in at least one instance.

A key factor, however, is that in all test modes and configurations, at all locations, the systems performed far in excess of expectations. Voice quality and intelligibility were at a level previously unachievable for any deployed system over narrowband circuits. System operation was clearly demonstrated to be simple and require little more operation than the present AUTOVON system. System installation into existing plant required only a few hours from start of installation to initial operation. The portion of the system containing the RED/BLACK interface successfully passed TEMPEST tests.

1.5 Report Organization

Section 1.0 of this report covers program background, objectives, approach, and results. System design considerations are discussed in Section 2.0. Section 3.0 describes hardware details. A summary of the various tests and demonstrations, including TEMPEST testing, is provided in Section 4.0. Various modes of operation are delineated in Section 5.0. Specific installation criteria are presented in Section 6.0. Conclusions and recommendations are provided in Section 7.0. Appendix A contains the Acceptance Test Procedure and Appendix B the EURCOM demonstration results. Systems used in actual operational situations of Gallant Eagle 80 are discussed in Appendix C. Horizon South-80 demonstration covered in Appendix D.

2.0 SYSTEM DESIGN CONSIDERATIONS

2.1 Background

The VINSON/AUTOVON Adapter is designed to provide widespread secure voice communication. The cost, complexity, and relative difficulty in using the present AUTOSEVOCOM system has limited its use. VINSON/AUTOVON Adapter terminals enable secure voice communications obstacles to be overcome.

The estimated cost of the resulting terminal is modest and additional cost savings result since the terminal does not require conditioned circuits. In addition, the COMSEC equipment is a widely used member of a versatile encryption/decryption device family that is currently in volume production. Most of the associated electronic hardware and software used for the modem is field tested, and only changes adding control logic and encryption/decryption equipment have been necessary.

The complexity of the VINSON/AUTOVON adapter system is less than that of existing narrowband or wideband systems. Existing systems frequently present tradeoffs among operating locations. Simple subscriber procedures are sufficient for ready access to a limited group of subscribers, with the presence of a corps of operating personnel to arrange, patch, and supervise the call setup to distant users. An isolated subscriber can establish his own calls without supporting personnel if he utilizes the more complex procedures necessary in the less sheltered environment.

Many users tend to "talk around" classified information with resultant compromises and near compromises. Lack of natural speech patterns and inconsistent speech recognition in present narrowband systems leaves many users reluctant to use the system even when available. The VINSON/AUTOVON Adapter solves these problems by making it possible for a user with AUTOVON access to have secure voice system access.

2.2 System Overview

Arrangements are available which make the VINSON/AUTOVON Adapter compatible with existing equipment with little more equipment, at most locations, than additional jacks on the SECORD panel and a relay in the RED area.

Figure 2.2 is the VINSON/AUTOVON Adapter basic block diagram. Audio to and from the handset travels one of two general paths. If the control logic is in the CLEAR mode then the handset is connected to the telephone lines via the RED/BLACK box; the standard existing telephone instrument; and the line select switch or relay. If the SECURE mode is selected, then the RED/BLACK box connects the handset to one or two KY-58's which transform the normal audio to and from an encrypted digital form. The bandwidth of the BLACK digital signals from a KY-58 extends beyond the bandwidth limits of the telephone lines used for an AUTOVON subscriber. The 16 KB/S modem performs another transformation on the signals enabling 3 kHz bandwidth of the telephone lines to be utilized while preserving the fidelity through use of a 16 KB/S data stream on the BLACK terminals of the KY-58(s).

2.2.1 Handset

The telephone handset normally attached to the telephone instrument is replaced. The new handset is widely available from independent telephone companies and contains a push-to-talk switch. Connections to the RED/BLACK box are made by adding a 9-pin plug to the furnished cable.

2.2.2 RED/BLACK Box

All switching of the audio to and from the handset takes place in this box. Primary importance is in performing switching at the RED level of audio and control leads while shielding these signals from the BLACK leads.

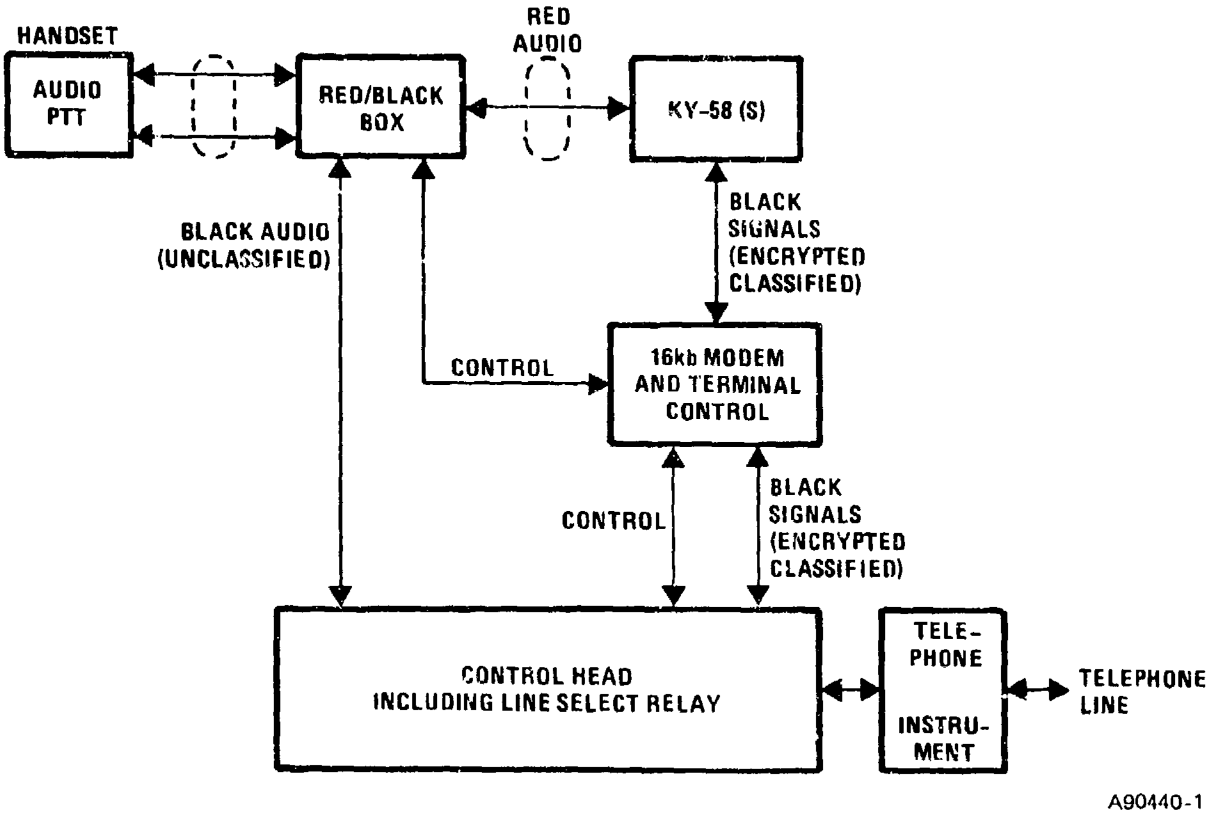


Figure 2.2. Basic VINSON/AUTOVON Adapter Terminal

Remote keying of the KY-58 can also be accomplished by control logic through relay actuation while retaining the high degree of RED/BLACK isolation required. Sensing of the KY-58 transmit mode through this high isolation barrier is made possible through the use of an optoisolator circuit. There is a relatively small component count in this box, but the value lies in achieving the degree of isolation to satisfy AFSS requirements for preventing interception.

2.2.3 KY-58

KY-58 is a stock COMSEC item with a proven performance record in a variety of applications. The KY-58 transforms analog voice signals into a high speed digital data stream or reverse the process. Two KY-58's are

simultaneously used in the full-duplex mode. Further descriptions are available in appropriate COMSEC literature. Power is provided by a dedicated power supply in the mounting case provided as part of the VINSON/AUTOVON adapter for one or two KY-58's.

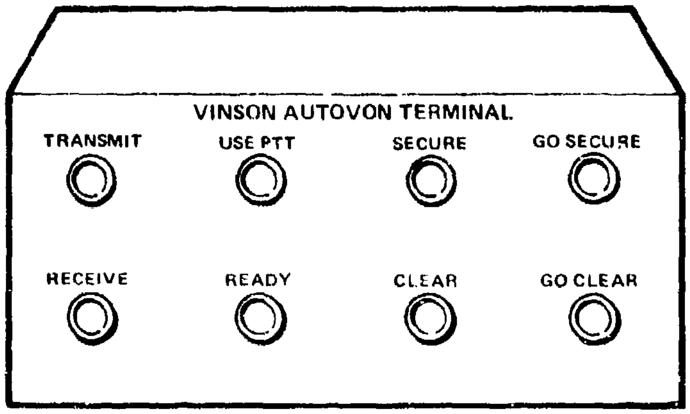
2.2.4 CONTROL HEAD

The CONTROL HEAD contains two pushbutton switches, six indicator lamps (all of which are reliable, trouble-free, longlife light emitting diodes), line select relays, and two rotary switches. These items, in conjunction with signals from other equipment and the on-hook switch, control the operation of the system. The front panels are shown in Figure 2.2.4. The RED/BLACK box will normally be attached to the rear, or contained within, the CONTROL HEAD box.

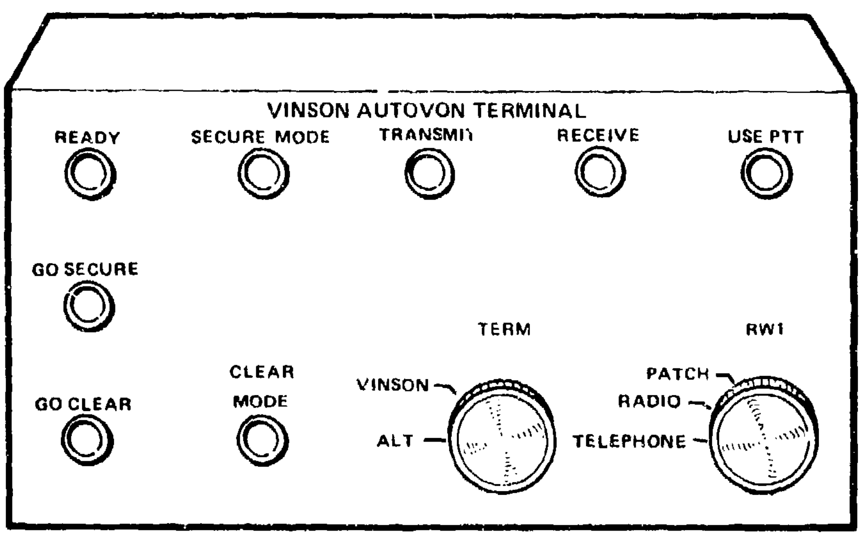
2.2.5 16 KB/S Modem and Terminal Control

The 16 KB/S modem is a Harris 5238 16 KB/S modem which has been adapted physically. No electrical changes have been necessary except to extend standard features and controls not normally relied on as primary features.

Physical changes include a high-stability crystal oscillator with low aging rate and special power supply, two additional circuit cards, and wiring for functions contained in the modem chassis. The higher stability crystal oscillator and power supply permit extended period half-duplex operation without loss of synchronization. Two additional circuit cards provide for an elastic buffer to compensate for minor drift rates between the KY-58 output and 16 KB/S data modem input and the control logic. Power for these functions is taken from surplus capacity on the self-contained modem power supplies.



SUBSCRIBER CONTROL HEAD



OPERATOR CONTROL HEAD

A90440-3

Figure 2.2.4. CONTROL HEAD Front Panels

2.2.6 Telephone Instrument

A standard AUTOVON telephone instrument is employed in the VINSON/AUTOVON Adapter. This reduces the number of custom engineering installations to only those which require the installation of an AUTOVON circuit, and those special efforts which would be a normal part of the AUTOVON circuit engineering tasks.

Three modifications are necessary to an AUTOVON instrument used with VINSON/AUTOVON Adapters.

1. Replacement of the regular telephone handset by one incorporating a push-to-talk switch.

2. Connection of the cable from the CONTROL HEAD to the original handset terminals or other terminals.

3. Installation of an "on hook" switch to signal the control logic that a call has been concluded when the handset is returned to the cradle.

2.3 System Interfaces

The interfaces required by the VINSON/AUTOVON Adapter are typical of this type of communications terminal. Two external power connections are required for the 16 KB/S data modem and VINSON CABINET, plus connection into the telephone communications system.

The VINSON/AUTOVON Adapter requires a nominal 110-volt single-phase, 60 Hz power source for both the modem and VINSON CABINET. The 16 KB/S data modem power supplies require approximately 100 watts and furnish power to the modem and attached loads. The external devices are loads on only the modem power supply and are comprised of relays, LED indicators, and

miscellaneous solid-state devices. All external +5-volt buses are connected to an internally accessible fuse dedicated to external loads; this prevents an external malfunction from either damaging cables or disrupting the operation of the internal modem circuits.

The VINSON CABINET power supply requires approximately 35 watts and furnishes power to only 28-volt loads within the VINSON CABINET (e.g., either one or two KY-58's). It is over rated to accommodate the starting power surges encountered with the KY-58 turn-on load.

The 16 KB/S data modem is strappable to provide 0 to -18 dBm output. The input operates over the range of -5 to -45 dBm. Input and output impedances are 600 ohm with a balanced feed.

2.4 Modem Modifications

One key to the VINSON/AUTOVON Adapter is the 16 KB/S data modem which enables the transmission of the 16 KB/S data stream over an unconditioned voice grade channel. Within published constraints, the modem works over a voice path regardless of whether the voice grade channel uses time division multiplexing, frequency division multiplexing, or other specific modulation.

As originally designed, the modem provided full-duplex service with the transmitter and receiver portions operating simultaneously. Since two modes require half-duplex service, one change to the modem permits squelching the analog output when used in a half-duplex system.

The operation of the modem depends on "training" the receiver at each end to compensate for the aberrations and drift in the signal path. Internally, this is accomplished through the adjustment of an adaptive equalizer during the establishment of the communications circuit. Although this was previously done simultaneously in the full-duplex mode, the training cycles have been modified to permit this to be done sequentially when operating over a half-duplex circuit.

During earlier full-duplex operation, each modem was continually updating and correcting equalizer and filter circuits. However, this is no longer possible with the advent of half-duplex modem operation, and the modem receiver has been modified so that equalizer adjustments may be "frozen" during times of transmission. This obviates a requirement to retrain a receiver during each turnaround.

The modem is sensitive to phase variations of the received signal. Another difficulty associated with half-duplex operation is the error signal generated by drifts of the time bases. This problem arises from the lack of reference signal to receiver during a unit transmit cycle. If this transmit cycle is of long duration, the receiver will lose synchronization with the distant end transmitter. To lengthen transmit time without loss of synchronization, a crystal oscillator with a slower aging rate has been incorporated into the VINSON/AUTOVON Adapter.

Two related changes have been incorporated into the communication circuit interface. Bridging the line allows the terminals to remain in the clear mode until one end initiates the secure mode. This bridging circuit enables the other terminal to disconnect the clear termination load, terminate the secure termination load, and initiate the training cycle; in one operation. The signal from the initiating terminal also imparts information to make the correct choice between full-duplex or half-duplex operation.

3.0 HARDWARE DESCRIPTION

This section provides a concise functional overview of the operation and design philosophy of the VINSON/AUTOVON Adapter. The overall connection diagram is shown in Figure 3.0-1 with CONTROL HEADs for two alternate configurations. These connector designations agree with other diagrams in this report. Figure 3.0-2 identifies the connectors and their locations in a terminal.

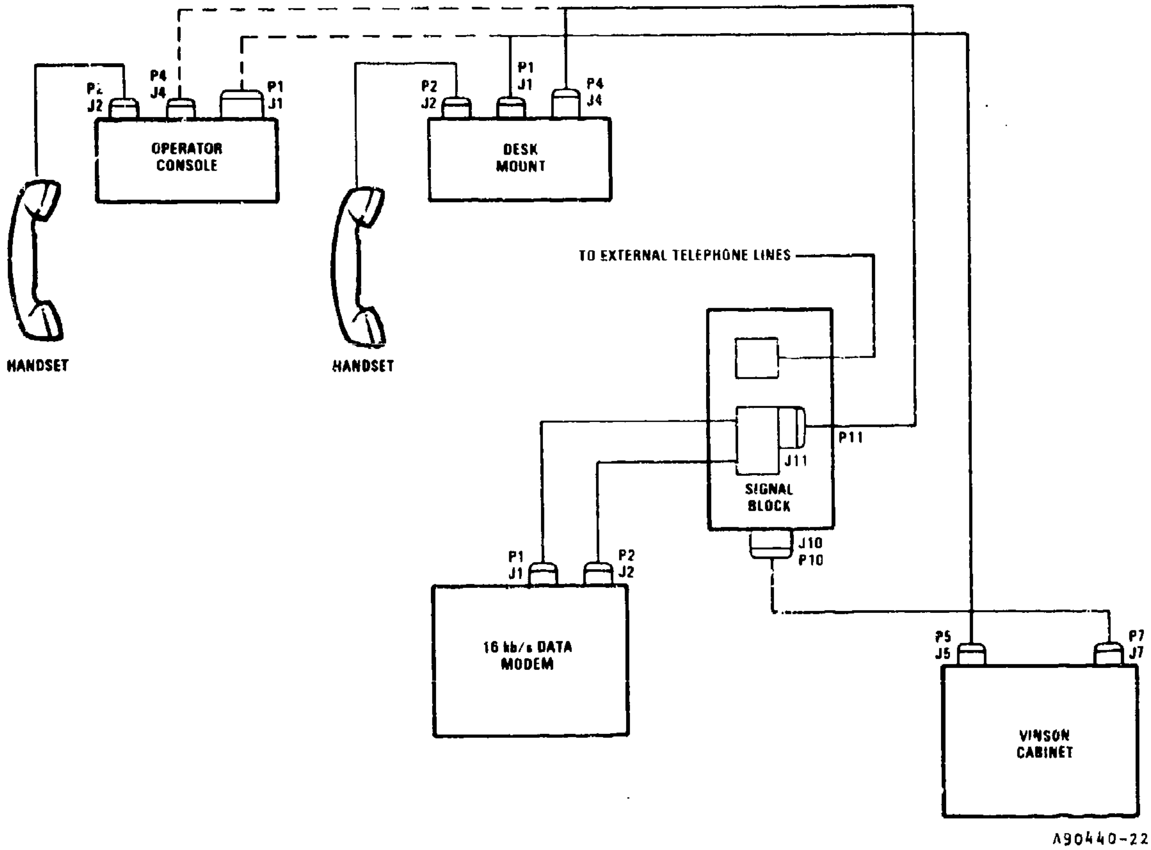


Figure 3.0-1. VINSON/AUTOVON Adapter Connection Diagram

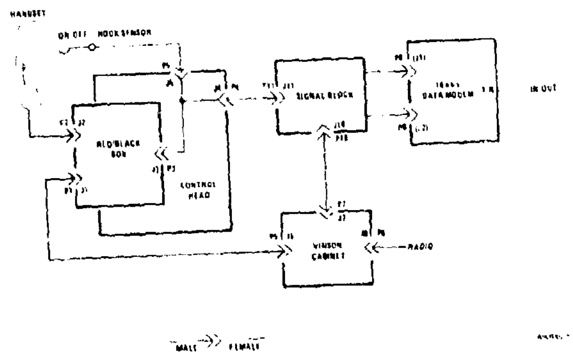


Figure 3.0-2. VINSON/AUTOVON Adapter Terminal Connector Identification Diagram

Subassembly	Connector Description	Vendor and Part Number
Handset		
P2	9 pin female plug	Cannon DEMM9S
RED/BLACK Box		
J1	9 pin female chassis	Cannon DEMM9S
J2	9 pin male chassis	Cannon DEMM9P
CONTROL HEAD		
J4	50 pin female chassis	Amphenol 57-20500
VINSON CABINET		
J5	9 pin chassis	Cannon DEMM9S
J7	25 pin male chassis	Cannon DBMM25P
Signal Block		
J10	25 pin male chassis	Cannon DBMM25P
J11	50 pin female chassis	Amphenol 57-20500-7 (furnished with block)

(Note that there are two cables connecting to the signal block from the 16 KB/S data modem which are directly wired into the signal block and have no connectors on the signal block end.)

Subassembly	Connector Description	Vendor and Part Number
16 KB/S Data Modem		
J1 (J8)	25 pin female chassis	Cannon DBMM25S
J2 (J9)	25 pin female chassis	Cannon DBMM25S

3.1 Handset and Telephone Clip

The handset and telephone clip assembly is composed of two subsystems. The first is a modified push-to-talk handset with cable. The end of the cable is modified to accept a 9-pin plug for connection to the RED/BLACK box assembly. No modification has been made to the handset or cord other than adding the plug.

The telephone clip assembly contains a microswitch mounted onto a mechanical lever to sense when the handset has been replaced on the telephone cradle and return a signal to the system. A diagram for both items is shown as Figure 3.1.

3.2 RED/BLACK Box

The CONTROL HEAD comes in two versions. The RED/BLACK box fits within either type of CONTROL HEAD used in the VINSON/AUTOVON Adapter. It contains a double-sided printed wiring board which provides etched wiring. The inner box circuitry has six relays, three used for secure switching. One is used for remote push-to-talk keying of the radio, and two are used as second stage isolation between RED and BLACK areas.

There are three connectors on the RED/BLACK box; RED signal 9-pin male connector (J2) for the handset; RED signal 9-pin female connector (J1) to the VINSON CABINET; and BLACK signal 24-pin female connector (J3) to the CONTROL HEAD wiring. The BLACK connector is an Amphenol slide connector, or equivalent, which carries the BLACK signal lines as well as power, sensing, and control lines.

The plug to the BLACK connector (J3) comes from a cable within the CONTROL HEAD and attaches to the RED/BLACK box within a CONTROL HEAD. The leads in the cable to the BLACK connector emanate from a cable which is

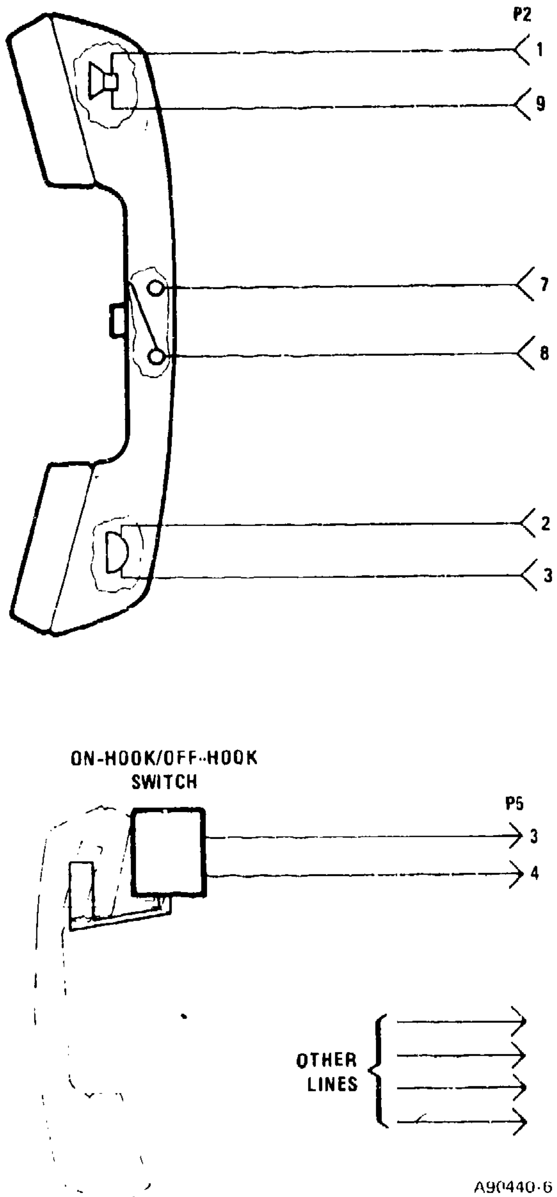


Figure 3.1. Handset and Telephone Clip Diagram

partially terminated to other circuitry within the CONTROL HEAD. Cables from the RED connectors leave the enclosure directly. One connects directly to the handset and the other connects to the VINSON CABINET.

Internal circuitry of the RED/Black box contains a two-section relay driver and an optical isolator. The optical isolator permits direct sensing push-to-talk switch status in the BLACK area as required for some operational modes. The relay drivers isolate the RED signals from the BLACK power by the semiconductor switching of relays in the more critical RED area. One of the secondary relays, providing a second stage of isolation from the RED area, is a magnetic latching relay and, consequently, requires either a latch or unlatch control signal from the control circuitry to change state. Resistors and capacitors in the RED/BLACK box are primarily used for isolation of the RED signal from the BLACK signal lines.

The RED/BLACK box contains two safety features designed into switching systems of this type. Examination of the schematic in Figure 3.2 reveals that the handset microphone leads are switched between only the microphone connections on the telephone and the microphone connections on a KY-58. The handset earphone is switched between earphone connectons on the telephone and the KY-58 audio output. The leads from these two devices are split among three relays so that an acknowledgement secure indicator can be incorporated into the terminal. If the handset leads do not properly switch, then the possibility of someone inadvertently talking down an insecure line is greatly reduced. This protection is extended by the use of a magnetic latching relay in the transmit path, which requires positive commands from the control logic card to latch and unlatch. The possibility of a power fluctuation returning two subscribers to the clear mode while they continue to talk is eliminated.

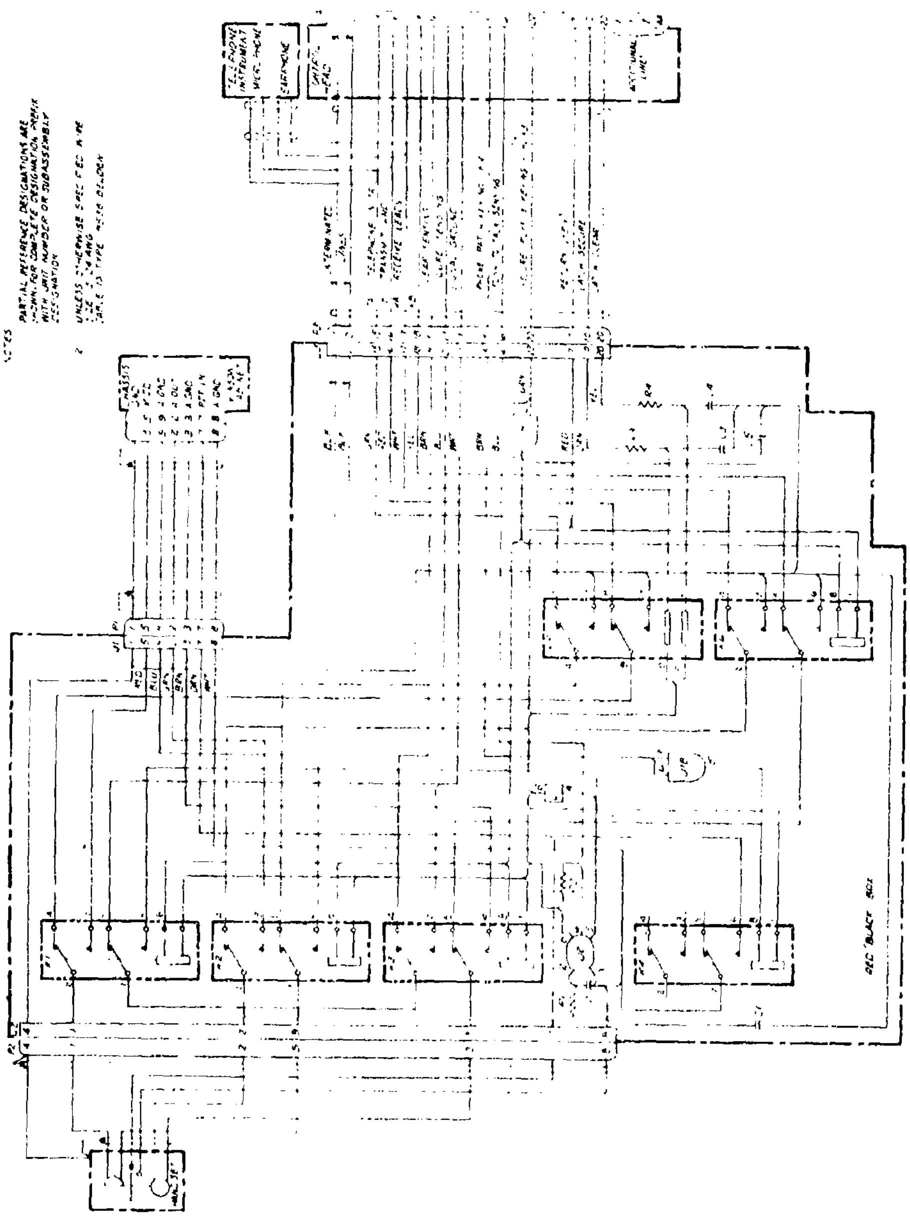


Figure 3.2. Connection Diagram RED/BLACK Box

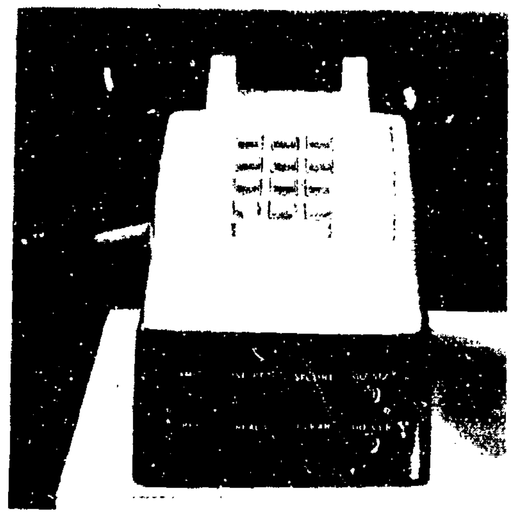
Another design feature is the master pin assignment system for the RED audio cables. A subscriber handset is used at the VINSON CABINET for crypto key changes through an auxillary cable, but connects the microphone leads to two ground leads. This prevents unauthorized, accidental access or intrusion to an operational system at the RED/BLACK box on the VINSON CABINET cable connector, but allows full use of the receiver capability for periodic key change without requiring a dedicated handset for this function. It the handset is adjacent to the VINSON CABINET at key change time, then nothing more than a transfer to the SECURE mode is necessary, and no recabling is necessary; the foregoing description is appropriate only when the CONTROL HEAD and VINSON CABINET are separated.

3.3 CONTROL HEAD

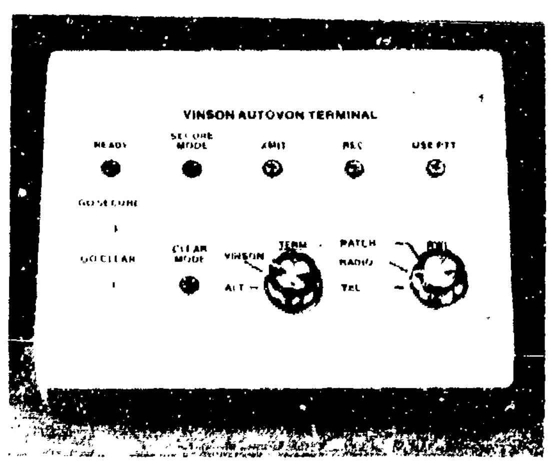
There are two versions of the CONTROL HEAD. (Figure 3.3-1) The subscriber terminal CONTROL HEAD contains the minimum functions necessary to operate a terminal. The operator CONTROL HEAD has additional functions available which are necessary or useful when a third-party traffic path is established. Figure 3.3-2 indicates additional features required for an operator CONTROL HEAD (i.e., TERMINAL and PHONE PATCH MODE rotary switches).

Figure 3.3-3 indicates the continuity from J4-P4 to the appearance on the signal block pins. The operation of SECURE LAMP and CLEAR LAMP, which are mutually and dependently exclusive events, gives an indication that the cabling is connected when the power is on.

The jumpers indicated in Figure 3.3-4 provide the return path for these functions. As an example, the CLEAR LED is connected to the common +5 volts through pin J4-8 from P4-8 and signal block pin 16. The other side is connected to light the LED in the CLEAR mode, in succession through R6, J4-27, P4-27, signal block pin 3, jumped to signal block pin 18, P4-9, J4-9, P3-9, J3-9 on the RED/BLACK box, K3-4, K3-2, K1-7, K1-5, J3-11, P3-11, J4-11, P4-11, and the connection to signal ground on signal block pin 22.



Subscriber Control Head



Operator Control Head

Figure 3.3-1. Terminal Control Heads

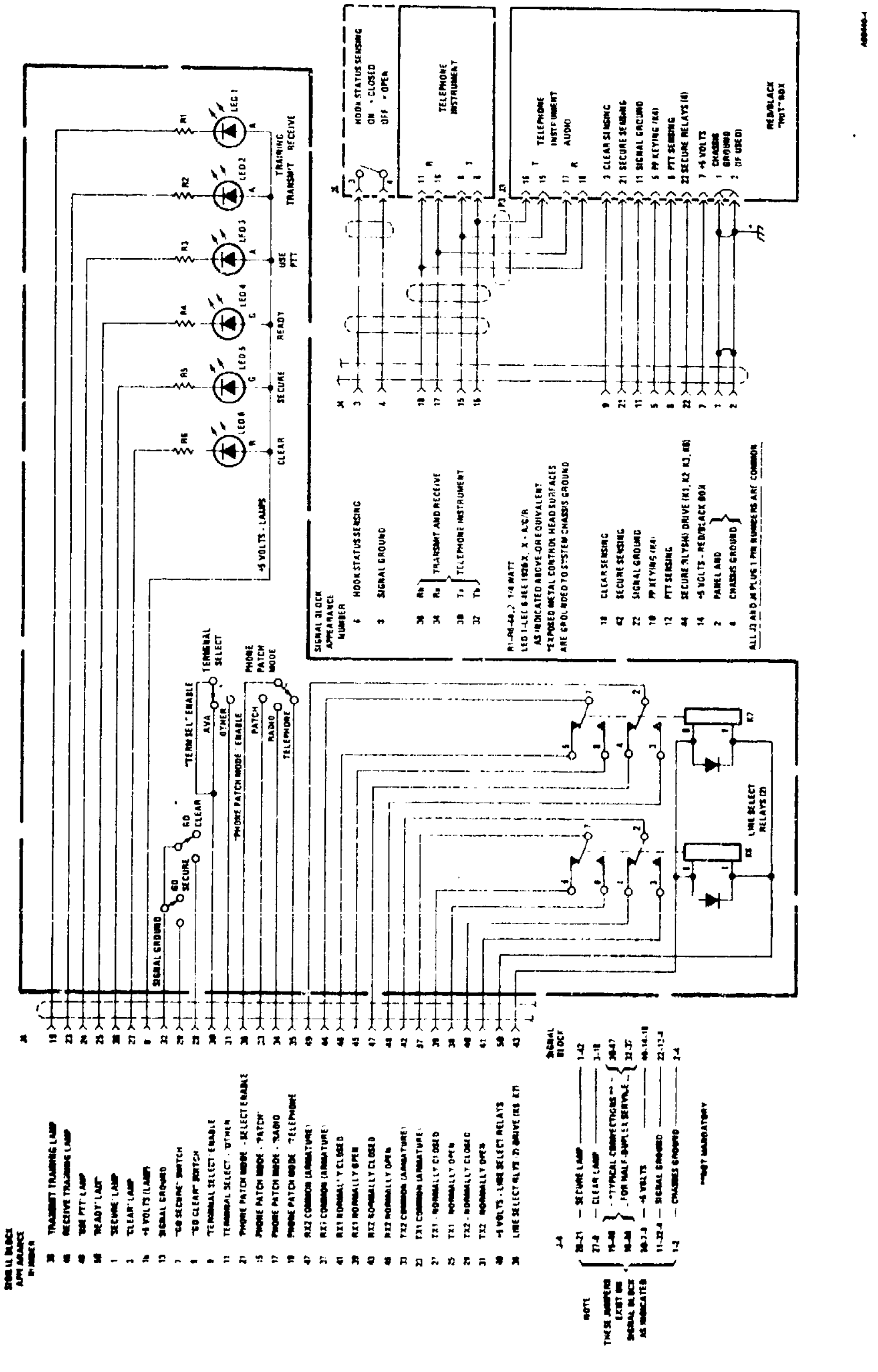


Figure 3.3-2. Circuit Diagram

Connector J4	Description	Signal Block Pin Appearance Number
1	Panel and Chassis Ground	2
2	Panel and Chassis Ground	4
15	Ta Telephone Instrument Transmit and Receive	30
16	Tb Telephone Instrument Transmit and Receive	32
17	Ra Telephone Instrument Transmit and Receive	34
18	Rb Telephone Instrument Transmit and Receive	36
3	Hook Status Sensing	6
4	Signal Ground	8
9	Clear Sensing	18
21	Secure Sensing	42
11	Signal Ground	22
5	PP Keying (K4)	10
6	PTT Sensing	12
22	Secure RLYS (4) Drive (K1,K2,K3,K6)	44
7	+5 volts - RED/BLACK Box Relays	14
19	XMT Training Lamp	38
23	RCV Training Lamp	46
24	USE PTT Lamp	48
25	READY Lamp	50
26	SECURE Lamp	1
27	CLEAR Lamp	3
8	+5 volts-lamps	16
32	Signal Ground	13
29	Go Secure SWC	7
28	Go Clear SWC	5
30	Terminal Select Enable	9
31	Terminal Select Other	11
36	Phone Patch Mode - Select Enable	21
33	Phone Patch Mode - Patch	15
34	Phone Patch Mode - Radio	17
35	Phone Patch Mode - Telephone	19
41	TX2 - Normally Open	31
40	TX2 - Normally Closed	29
38	TX1 - Normally Open	25
39	TX1 - Normally Closed	27
37	TX1 Common (Armature)	23
42	TX2 Common (Armature)	33

Figure 3.3-3. Cross-Connect Chart
VINSON/AUTOVON Adapter Terminal Control Head (Sheet 1 of 2)

Connector J4	Description	Signal Block Pin Appearance Number
48	RX2 - Normally Open	45
47	RX2 - Normally Closed	43
45	RX1 - Normally Open	39
46	RX1 - Normally Closed	41
44	RX1 Common (Armature)	37
49	RX1 Common (Armature)	47
50	+5 volts-Line Select Relays	49
43	Line Select Relays (2) Drive (K6,K7)	35

Figure 3.3-3. (Continued) Cross-Connect Chart
VINSON/AUTOVON Adapter Terminal Control Head (Sheet 2 of 2)

Apparent Jumper: Jumper:

Connector J4-P4	Description	Signal Block Pin Appearance Number
26-21	SECURE Lamp	1-42
27-9	CLEAR Lamp	3-18
50-7-8	+5 Volts	49-14-16
11-32-4	Signal Ground	22-13-8
1-2	Chassis Ground	2-4

Figure 3.3-4. Signal Block Jumpers

From tracing the above path and the SECURE LED path, it is obvious that any cable disconnection in this path will disable these LED circuits. This safety feature was implemented to assure dependable indications to the user.

3.3.1 Subscriber Terminal Control Head

The subscriber terminal CONTROL HEAD is the basic CONTROL HEAD. The box is designed to fit underneath standard telephones found in military and civilian telephone systems. There are two pushbutton switches on this CONTROL HEAD to switch logic states controlling the secure and clear modes. Three connectors are associated with this CONTROL HEAD: a 25-pin male cable connector (P3) connected to the RED/BLACK box installed within the CONTROL HEAD; a 50-pin Amphenol female chassis connector (J4) attached to the side of the CONTROL HEAD; and a 15-pin Amphenol female chassis connector (J5) attached to the rear to switch telephone leads.

The indicators are light emitting diodes of the same type, style, and number used in the other CONTROL HEAD. There are one red, two green, and three yellow LED's in this box. In addition, there is a printed circuit board containing two relays used for line selection purposes and six LED dropping resistors.

3.3.2 Operator Control Head

Two rotary switches have been installed in addition to switches used in the subscriber terminal CONTROL HEAD. A one-pole, three-throw switch is required to switch among the various RWI configurations. A four-pole, two-throw switch allows a direct line switching. An additional connector (J6) has been provided to accommodate direct line switching.

Operator CONTROL HEAD indicators are identical to those on the terminal CONTROL HEAD, and have the same colors associated with the same functions as on the subscriber terminal CONTROL HEAD although they are laid

out differently. The board containing two relays and six LED dropping resistors has been redesigned for this application. The BLACK connection to the RED/BLACK box is made internally but two red connections are made on the external surface protruding slightly through the rear.

3.4 VINSON CABINET

The VINSON CABINET is a modified standard instrument case. The top has been perforated to permit air flow and a 3-inch fan has been installed on the rear panel to provide forced air flow throughout the box. The front panel has been cut to accept two KY-58 units through the use of Dzus fasteners. In addition, a dummy panel is provided as standard equipment on all VINSON CABINETS to be used in installations requiring only one KY-58 without sacrificing effective air flow.

Figure 3.4 depicts the wiring of the VINSON CABINET. There are three sets of connectors within the VINSON CABINET: two connectors to each KY-58 carrying RED, BLACK, power and control signals; and three connectors carrying signal information on the rear of the cabinet. The 9-pin connector (J5) provides connections to the RED/BLACK box and carries RED audio. The 15-pin connector (J6) provides connections to a radio system and carries BLACK audio and control signals to and from the radio. The 25-pin connector (J7) provides connections to and from the control logic card for sense and control signals. The power connector is a standard power cord which plugs into the area panel-mounted power line filter for EMI suppression.

There are three sets of controls on the VINSON CABINET. The power control is located at the upper right corner of the rear panel, and provides primary power to the power supply furnishing regulated voltage to the VINSON units. Two front panel controls are used for cryptographic loading operations of the KY-58. There are two switches which must be switched when transferring between two- and four-wire installations. One switch is

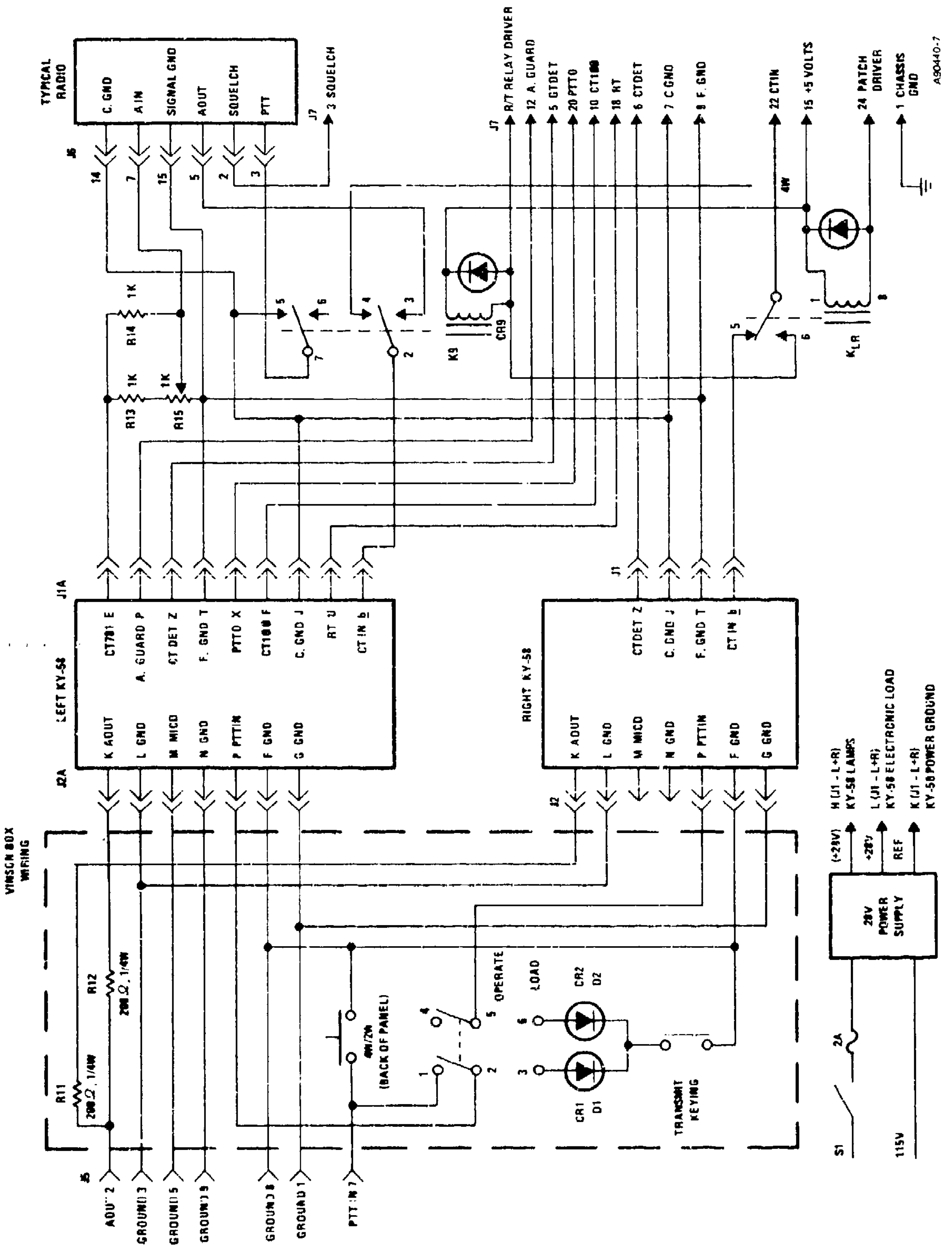


Figure 3.4. VINSON Box Wiring

mounted inside the VINSON CABINET and may be accessed through either KY-58 cutout hole. Another switch is mounted atop a subassembly and may be reached easily with one hand.

There are two printed circuit board subassemblies within the interior of the VINSON CABINET. The first one is contained in the RED audio subassembly box which provides shielding at the junction of the connections between the two VINSONS and to the cable going to the rear RED audio connector to the RED/BLACK box. The two switches mounted on the front panel must operate within the RED area at the cable junctions and, for this reason, the subassembly box which provides a shield around the RED signals exposed inside the box is screwed onto the front panel. There is also a BLACK signal board located on the power supply. This has a potentiometer to adjust signal levels sent to the radio transmitter and contains two relays used in mode switching.

The power subsystem within the VINSON CABINET is provided with a standard 28-volt power supply regulated ± 1 volt from the adjusted 28 volts. It is rated at 2 amperes to accommodate the starting surge current required by the KY-58 as well as to provide derating for temperature rise. In operation, it is very lightly loaded.

3.5 SIGNAL BLOCK

The SIGNAL BLOCK is not a major defined unit but is a major connection crosspoint for the subsystems interfacing with the 16 KB/S modem. It contains one 25-pair, and two 6-pair standard telephone cable block connectors. The SIGNAL BLOCK is mentioned here as a separate item since it is physically separate from all other units.

3.6 16 KB/S Data Modem Modifications

The VINSON/AUTOVON Adapter required a 16 KB/S modem modified for this application. It contains a high stability oscillator for a time-base generator with an aging rate of one part in 10E-9 per day, and a power supply capable of providing one amp at 28 volts power to the crystal oven and rapid heating of the crystal.

An internally accessible fuse holder has been provided between the standard 5-volt power supply within the 16 KB/S modem and the additional outside circuitry. The power supply provides 5 volts throughout the system where required. Two fuse holders are added, one of which contains a spare fuse.

There are two 5- by 8-inch wire-wrap cards installed in positions A7 and A12. The former contains the control logic and the latter is an elastic buffer. In addition to these modifications, a relay board containing a relay for terminating the line when the unit is not in a bridging mode is installed under the rear cover.

Logic diagrams of the control card and elastic buffer are provided in Figures 3.6-1 and 3.6-2.

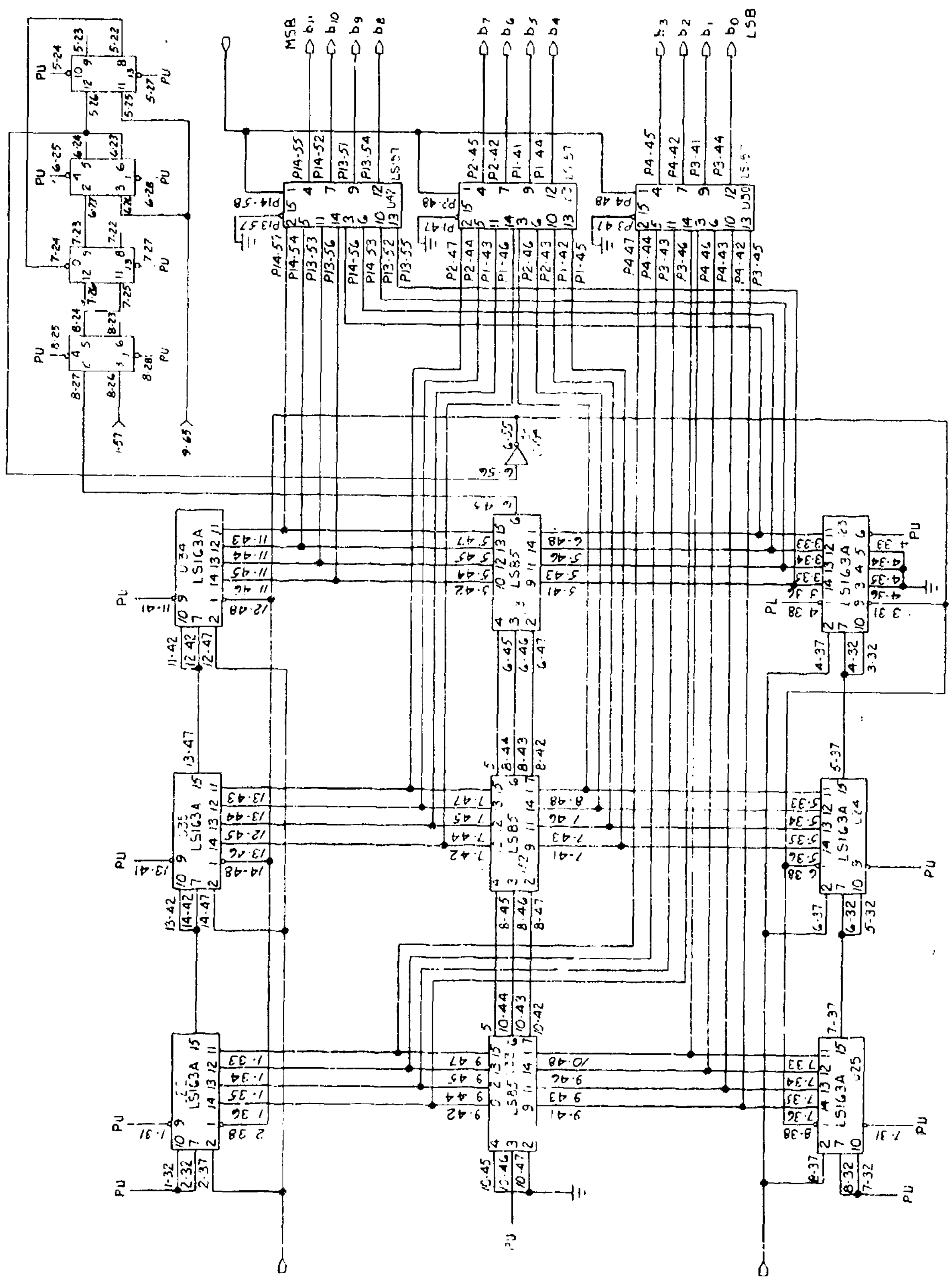


Figure 3.6-1. 16 KB/S Modem Card A7 Control Logic (Sheet 1 of 2)

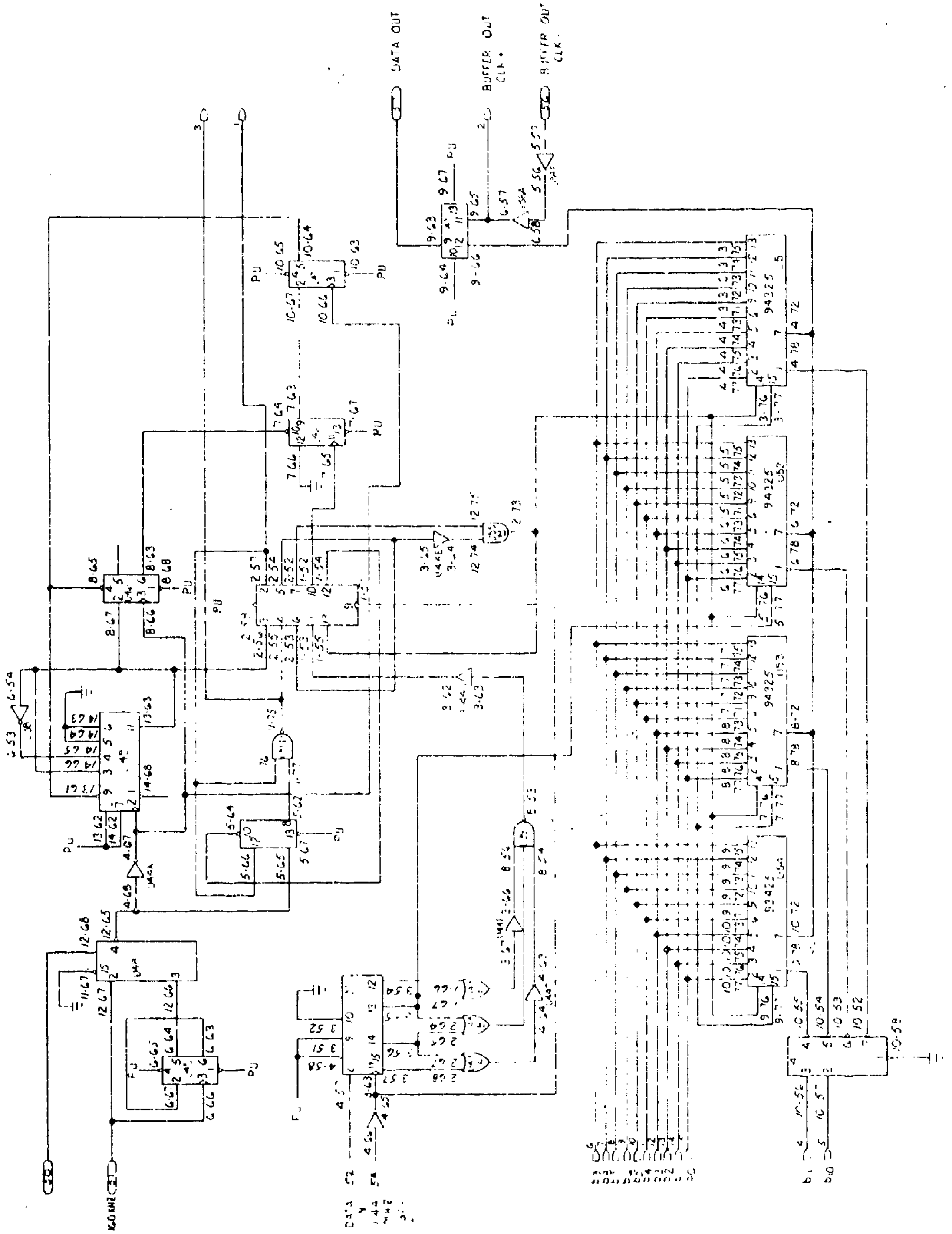


Figure 3.6-1. 16 KB/S Modem Card A7 Control Logic (Sheet 2 of 2)

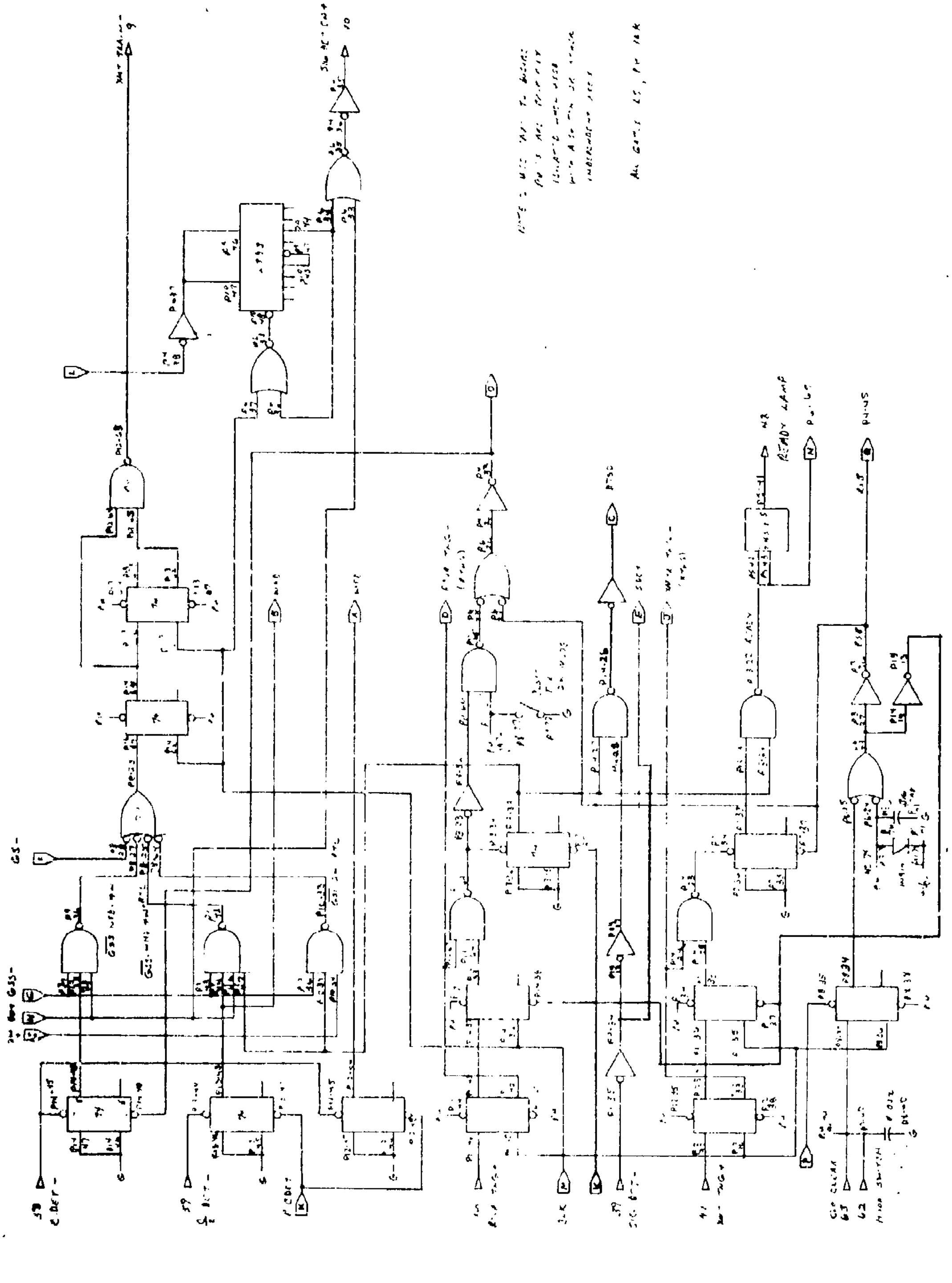


Figure 3.6-2. 16 KB/S Modem Card A12 Buffer (Sheet 1 of 2)

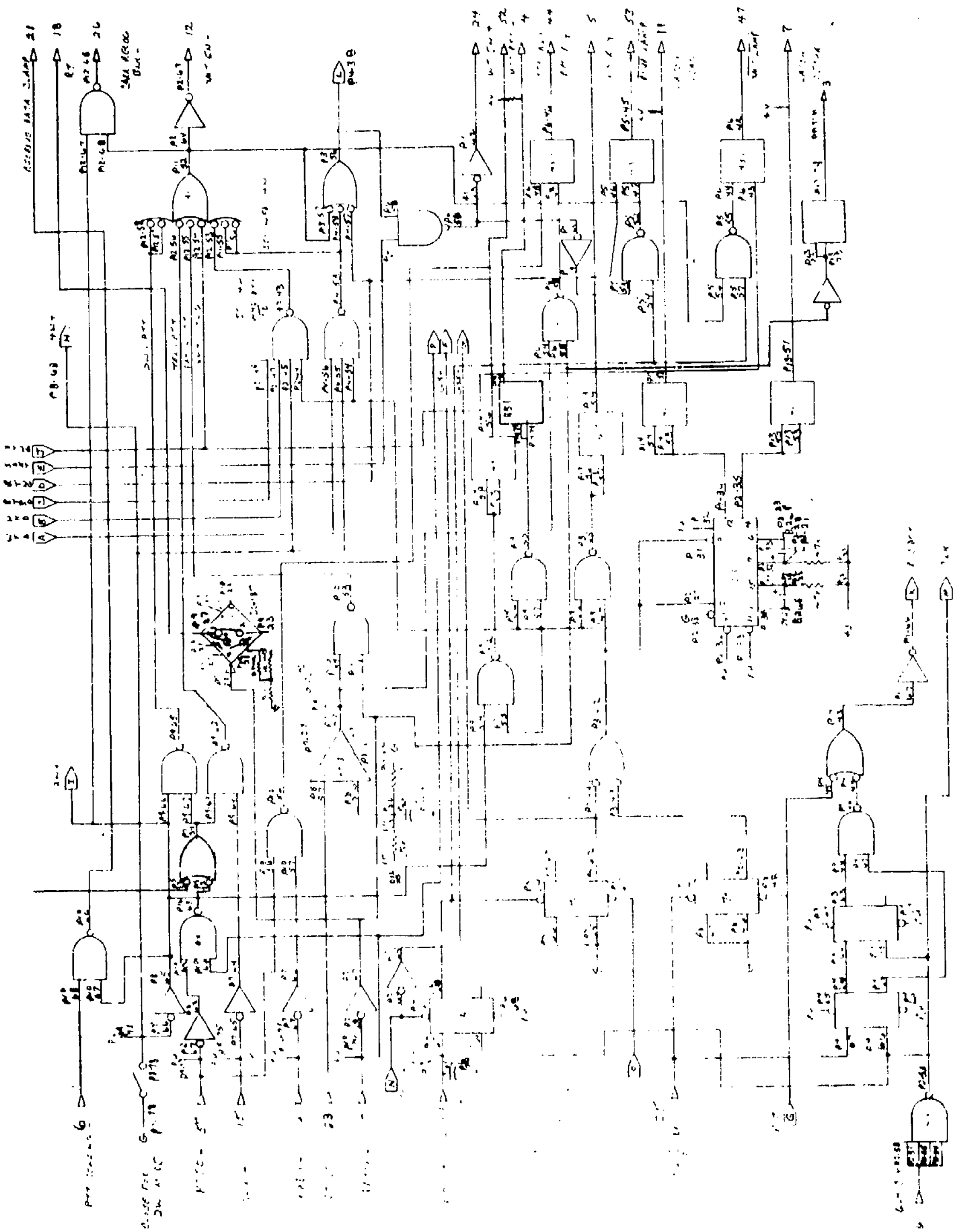


Figure 3.6-2. 16 KB/S Modem Card A12 Buffer (Sheet 2 of 2)

4.0 VERIFICATION, DEMONSTRATION AND TESTS

4.1 Field Verification and Demonstrations

One of the major objectives of the program was to verify the design adequacy of the VINSON/AUTOVON Adapter as well as to demonstrate it to the appropriate user community. During the design and development phase four versions of the terminal were developed in response to four specific, identified needs. The field test program, therefore, was designed to clearly show the adequacy of these different configurations. The four configurations which are discussed in detail in this report are as follows:

- SECORD/SEVAC
- Two-wire PBX Subscriber (Class A Telephone)
- Four-wire Direct AUTOVON Subscriber
- Radio Wire Integration (RWI)

Once the breadboard equipment design was completed, fabricated, and assembled, each terminal was staged at the Harris GSG facility, Melbourne, Florida. During this staging, terminals were tested with other terminals in order to verify, to the extent possible, each terminal's ability to operate in the various modes. Following this testing the terminals were burned in for a minimum of 2 days. The field installation process was one of gradual staging. A terminal (one of the four breadboard units) remained at Harris GSG until the first three field sites were operational and then it was moved to the final site. The first field installation was performed at the Readiness Command (REDCOM), MacDill AFB, Florida. This installation was at

the REDCOM SECORD. The installation directly interfaced with a spare KY-3. With normal SECORD patching, the terminal was capable of operating with any wideband subscriber at REDCOM. The narrowband interface was provided by use of existing H-Y-2 trunk.

Upon completion of the installation, the terminal was tested between REDCOM and Melbourne with the Melbourne terminal configured as both a two-wire and four-wire terminal. At REDCOM the terminal was tested directly from the SECORD and also in tandem with a KY-3 terminal. After a series of test calls in both directions, and various configurations, the system was demonstrated and briefed to appropriate REDCOM personnel.

This terminal was left operational at REDCOM and used for all subsequent tests and demonstrations. As of this writing the terminal is still operational for test purposes.

The second field installation was at TAC, Langley AFB, Virginia. This installation was a two-wire class A telephone subscriber off a PBX. The initial installation and test between Langley and MacDill was successful. However, the Langley terminal, due to its breadboard nature, proved to be less reliable than the MacDill terminal and required engineering adjustments. As with the MacDill terminal all possible combinations of tests were performed in all directions between the three test locations.

The third installation was the Radio Wire Integration (RWI), at SAC, Offutt AFB, Nebraska. This installation, by its nature, was very complex, requiring equipment installation and test at both the ground entry point (GEP) and on board an aircraft. A special mounting bracket for the aircraft KY-58 was fabricated and approved prior to installation on board the EC-135 aircraft. Static tests were performed from the aircraft on the ground to the GEP prior to testing over the system. Actual tests were performed from the aircraft in flight through the GEP to Melbourne, MacDill AFB and Langley AFB.

The terminal that remained at Harris was subsequently moved to The Pentagon and initially installed at the 758-C switch. After a series of successful tests to the existing locations, i.e., MacDill, Langley, and Offutt, a final demonstration was established for a duration of 1 week. During this demonstration, The Pentagon terminal was moved from the 758-C switch to a two-wire class A telephone drop within The Pentagon.

The Pentagon terminal was also moved to DCA Headquarters where it was connected to a four-wire direct AUTOVON access and tested. The demonstration activity involved hundreds of calls being made from various locations, including the Airborne Command Post while in flight. Successful calls, of excellent voice quality, were made to and from every possible configuration. The Airborne Command Post, as well as other test sites, was able to access parties through the inherent capabilities of The Pentagon 758-C switch. The majority of the demonstrations utilized government personnel acquainted with each other at the various installations as a test of voice recognition and quality. Government personnel also were utilized in many instances in placing the calls as a demonstration of simplicity of operation. All levels of personnel within the government participated in the demonstrations and were unanimous in their endorsement of the system.

Subsequent to the 1-week demonstration between the locations described, several other verification tests were performed. The first of these tests was between existing installations at Langley AFB, MacDill AFB and Melbourne and a four-wire line off the four-wire PBX at ADCOM. These tests were also highly successful. The only difficulty encountered was interference caused by sidetone generated by the four-wire PBX. Once the sidetone was disabled, the tests were performed without any difficulties.

The next series of tests were between existing installations at Langley AFB and Melbourne and new two-wire installations at Scott AFB and Kelley AFB. A peculiar situation was encountered during these tests since

the carriers from Scott AFB were either ON or N3 resulting in higher error rates than desirable, but yet providing good communications. The modem performed well on the N3 carriers (the error rates were relatively high) and marginally on the ON carrier system. The ON carrier systems are reported to be scheduled for replacement by T carriers in the near future.

A final demonstration was performed between the existing installations at MacDill AFB, Keesler AFB, and Melbourne. This demonstration was conducted in conjunction with the Senior Communicators' Conference in December, 1979. Some difficulty was encountered in setting up the demonstration due to the effects of echo suppressors between Keesler AFB and MacDill AFB. The echo suppressors could be disabled by dialing the data prefix from MacDill AFB. A similar problem was also experienced in early tests between Langley AFB and The Pentagon. The effects of dialing the data prefix were not evaluated due to the tight schedule, but it is believed this would also have been effective. The Keesler AFB installation was a two-wire Class A phone.

4.2 TEMPEST Test

The RED/BLACK portion of the VINSON/16 KB/S Modem terminal was subjected to appropriate TEMPEST test requirements of NASCEM 5100. The test results are classified and have been previously provided as a separate document.

5.0 SYSTEM OPERATION

5.1 Full-Duplex Configuration

This configuration is designed for installation on a four-wire AUTOVON subscriber line. This configuration corresponds to present AUTOSEVOCOM Narrowband Subscriber Terminal (NBST), but provides better voice quality and improved connectivity with tactical elements. A block diagram of the full-duplex terminal is shown in Figure 5.1. The CONTROL HEAD for the terminal is installed under the present four-wire AUTOVON telephone instrument, and the remaining equipment (KY-58 and modem) can be located anywhere within approximately 20 feet. The telephone handset is disconnected from the instrument and reconnected through the secure relay in the CONTROL HEAD. Also the telephone transmit tip and ring and receive tip and ring lines must be routed for equivalent switching. No other connections in the telephone instrument or the WECO 309 switching system (or equivalent) are disturbed. When the secure mode is not selected, or is turned off, the relays connect the entire telephone installation to the AUTOVON lines in the normal manner. Controls required for this configuration are:

a. A Go Secure momentary pushbutton on the CONTROL HEAD.

b. A hook switch, mechanically activated when the telephone handset is on the cradle.

A secure indicator light on the CONTROL HEAD is lit when the terminal is in the secure mode.

The only RED signals in the CONTROL HEAD are those associated with the handset audio leads to the KY-58 and the secure relay. This relay is located in a separate compartment and is specially selected to provide the required isolation.

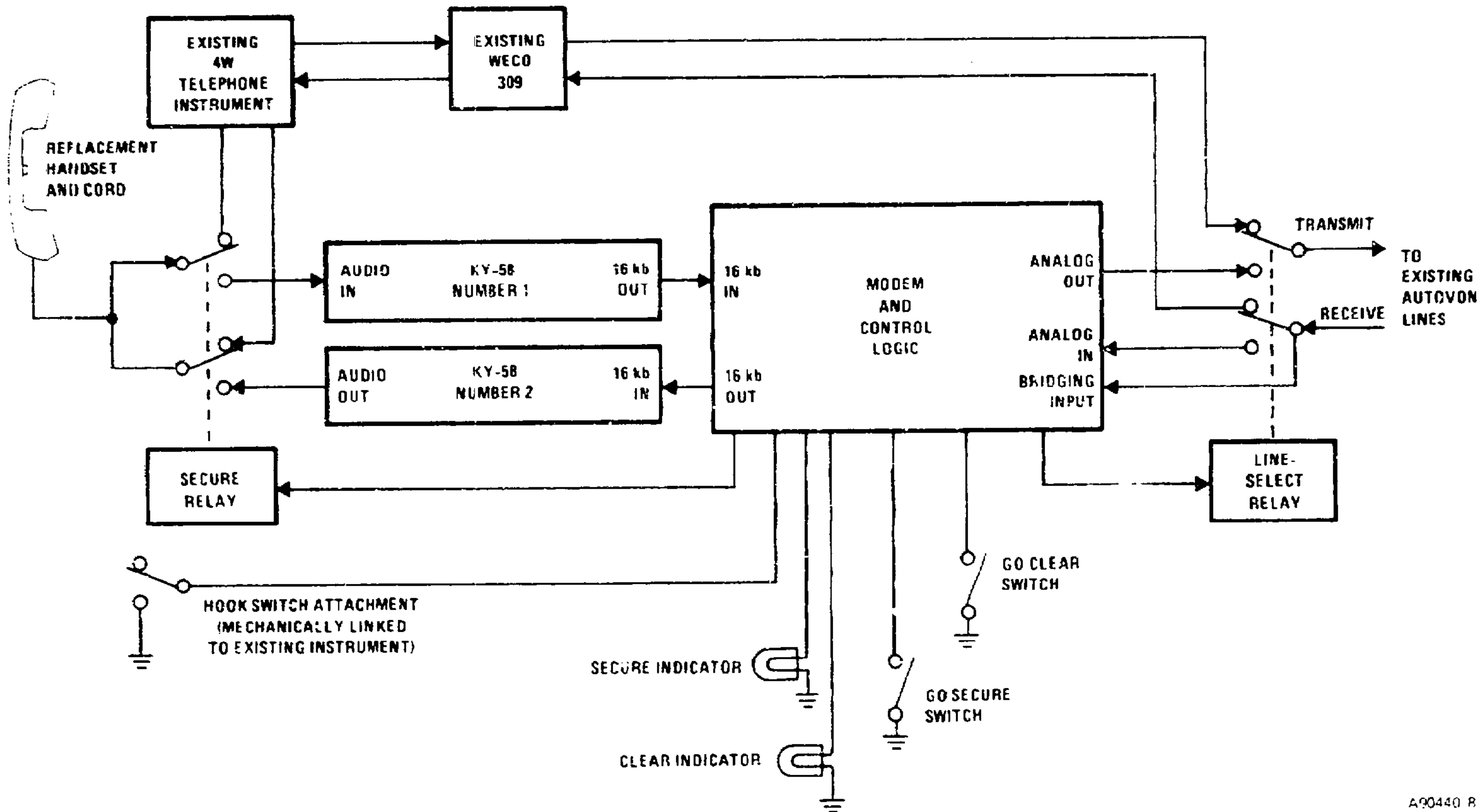


Figure 5.1. Simplified Full-Duplex Configuration Diagram for 4-Wire AUTOVON Subscribers

On the telephone line side, note that the modem receiver always bridges the receive line with high impedance. This allows the modem to sense an incoming Go Secure initiation signal regardless of the local mode. When in the secure mode, the normal termination in the WECO 309 is removed and the modem provides the line termination via the line select relay contacts.

5.2 Half-Duplex Configuration

For AUTOVON users behind a PBX, only two-wire service is available. The block diagram of the half-duplex configuration is shown in Figure 5.2. The handset connection is similar to that in the full-duplex terminal, except that a push-to-talk switch must be provided. Since this is not provided on the normal handset, a replacement handset is provided with this configuration, but the audio connections are the same as the standard handset. The push-to-talk switch goes directly to the KY-58. On the line side, only the two-wire tip and ring connection is involved. Again the modem is continuously bridging the line, and terminates it in the secure mode. The controls and displays are the same as for the full-duplex terminal.

5.3 SECORD/SEVAC Terminal Configuration

This configuration is designed to interface 16 KB/S users to wideband enclaves. As shown in the block diagram of Figure 5.3, the terminal is switched in-line in place of the existing 2.4 or 9.6 KB/S narrowband terminal. At the clear audio side, it inserts the secure relay in exisitng connection between the SECORD/SEVAC wideband and narrowband terminals. On the line side the switching is similar to that in the full-duplex subscriber terminal. The controls and displays are similar to the earlier configurations, except that the function of the hook switch is replaced by a manual Go Clear button, since the operator must manually restore the board to normal at the conclusion of the call.

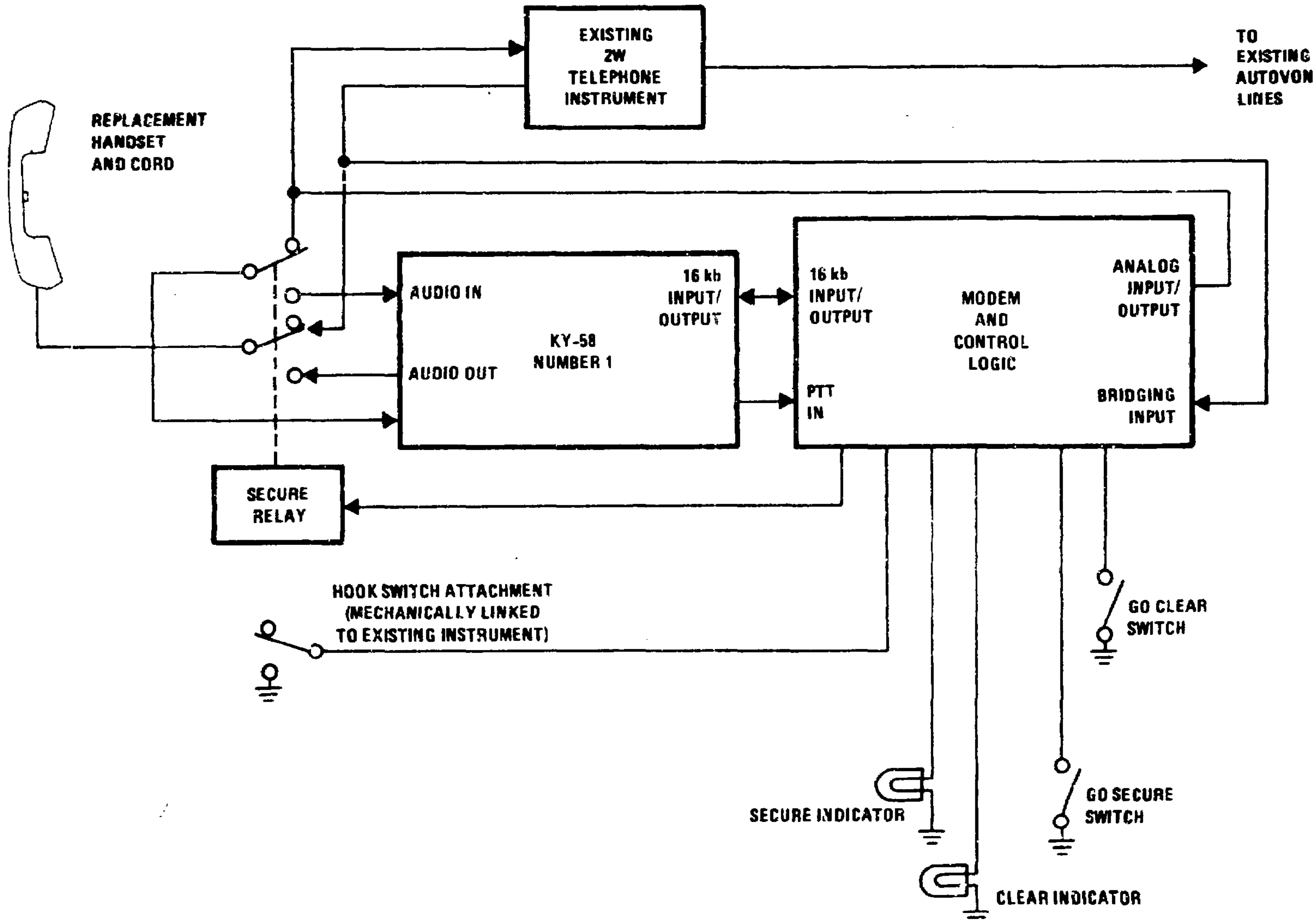


Figure 5.2. Simplified Half-Duplex Configuration Diagram for Two-Wire AUTOVON Subscribers

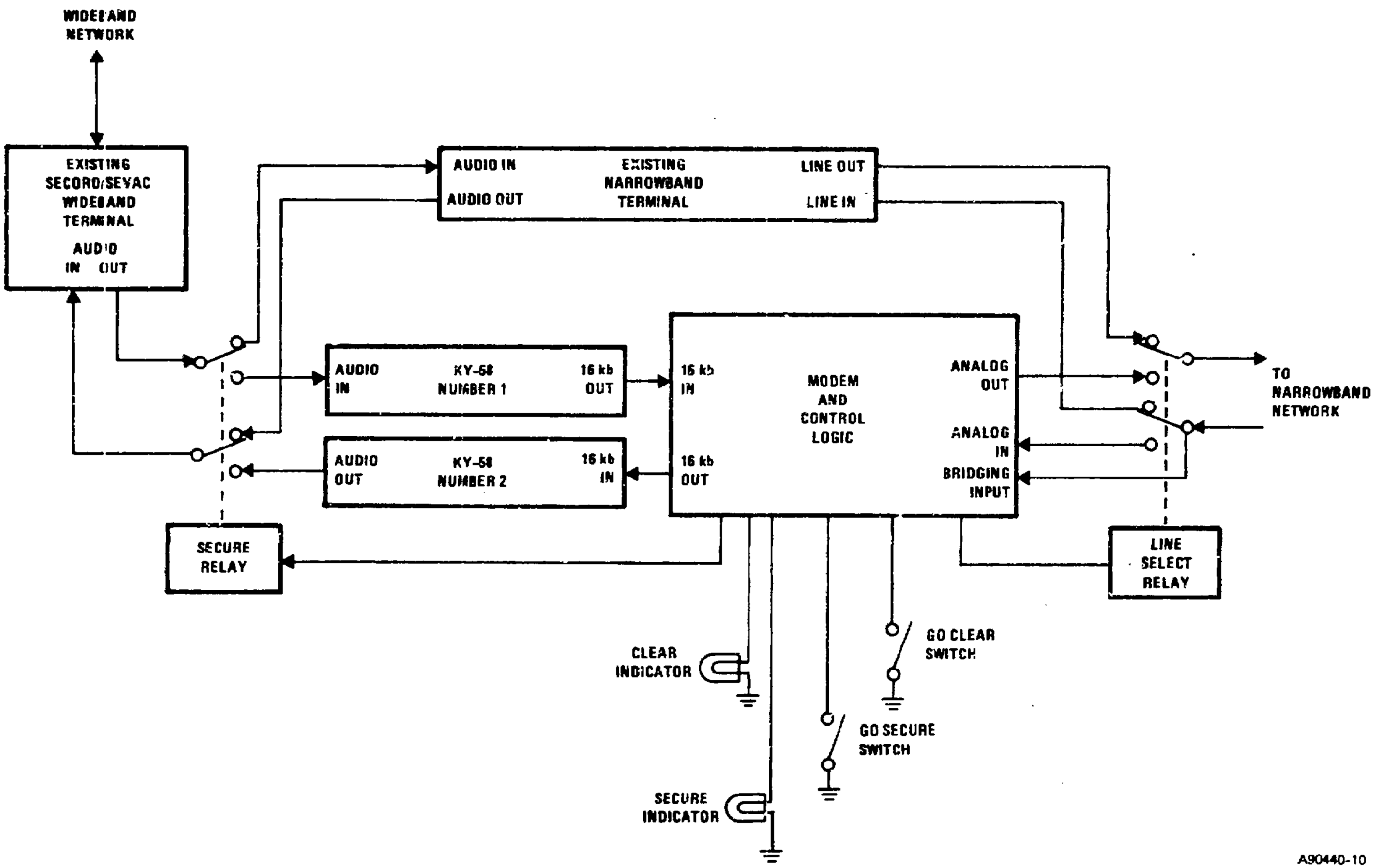


Figure 5.3. Simplified SECORD/SEVAC Configuration Diagram

5.4 Radio/Telephone Interface (Phone Patch) Terminal Configuration

This configuration provides the capability for a secure phone patch between a mobile user, such as an airplane, with a VINSON-equipped radio and any other terminal-equipped user or subscriber. One version of this configuration is shown in Figure 5.4. This configuration shows four-wire AUTOVON service, but two-wire configurations are possible. In the clear mode, the secure and line select relays provide normal use of the telephone system. Three secure operator modes are provided: to the telephone side; to the radio side; and with the two sides patched together. In the secure telephone mode, the terminal operates in a half-duplex configuration controlled by the PTT switch on the handset. In the secure radio mode, the 16 KB/S data of the KY-58 is switched by the R/T relay from the modem output to the radio audio output. The radio audio input is connected to a separate cipher text output from the KY-58, and the modem data input is connected to the normal output of the KY-58. Thus both the radio and the telephone links can monitor transmissions from the local handset during call setup, but only the selected link can transmit to the local operator. For the Phone Patch mode, the KY-58 is placed in the retransmit mode through the regenerate command line (RT). This causes the 16 KB/S data to be regenerated and placed on the 16 KB/S output terminals. Thus the downlink path from an airplane is from the radio audio output through the R/T relay to the KY-58 16 KB/S input, out the 16 KB/S KY-58 output connection to the modem digital data input and out onto the telephone link as an analog signal. The uplink path to an airplane is from the telephone link as an analog signal to the modem analog signal input, out the modem digital data output, through the R/T relay to the KY-58 16 KB/S input, out the 16 KB/S output (CT OUT) and to the radio audio input. The R/T relay as well as the radio and the modem must change modes depending upon the direction of transmission.

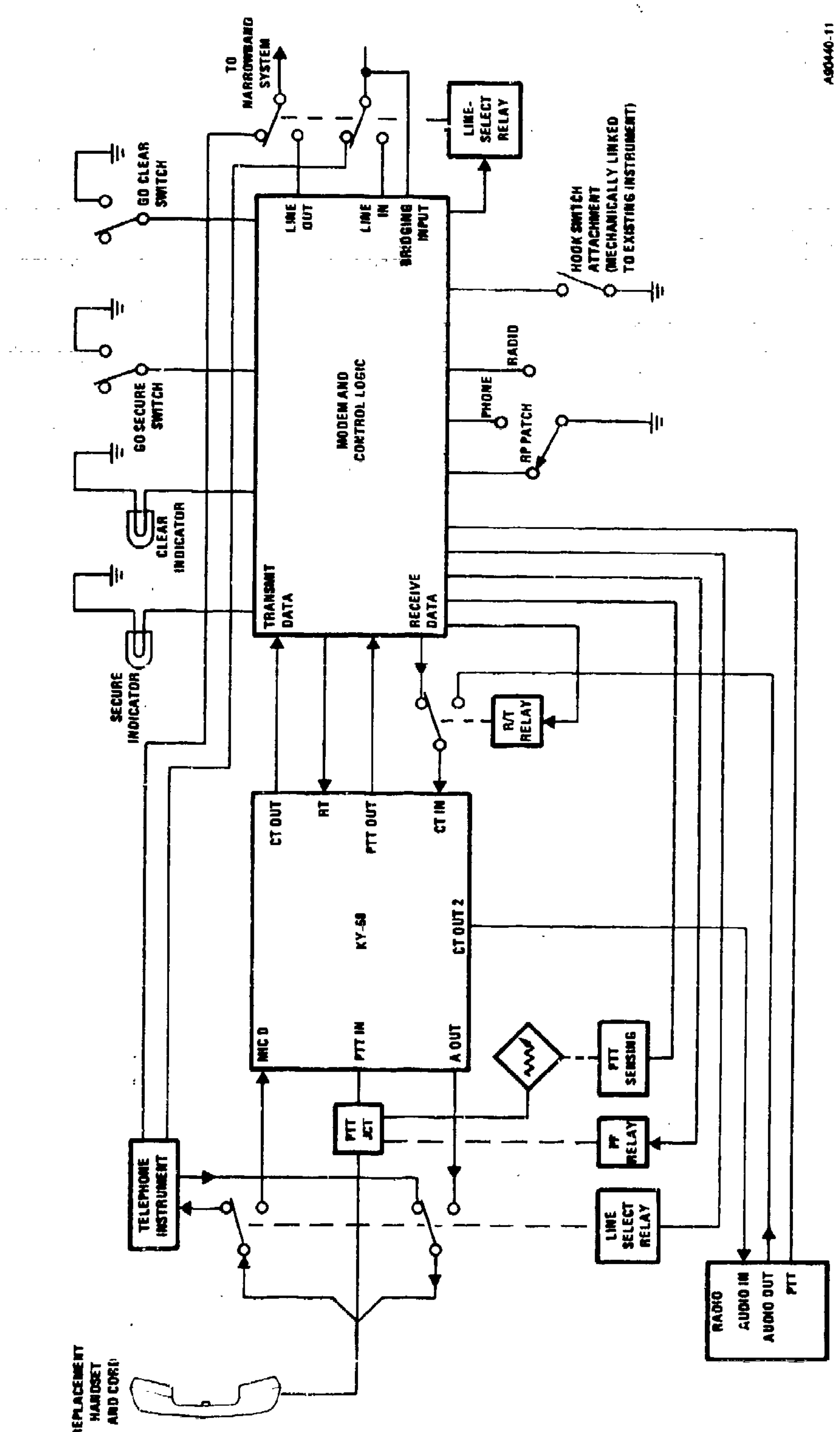


Figure 5.4. Simplified Radio - Phone Patch Configuration Diagram

5.5 Terminal Operating Procedures

The terminal operating procedures are as follows:

a. Calls are placed in the clear in identically the same manner as they are placed by present AUTOSEVOCOM subscribers. That is

   1. If the call initiator is a narrowband subscriber, he dials the appropriate AUTOVON number directly.

   2. If the call initiator does not have AUTOVON dialing capability, such as a wideband subscriber or a radio subscriber, he contacts an operator and requests that an AUTOVON call be placed. In this case the operator puts the initiator on hold until a secure link is "established" between the operator and the dialed AUTOVON connection.

b. Once the call connections are established in the clear, the AUTOVON link is secured by the following procedure.

   1. If the calling AUTOVON party has a full-duplex terminal, he requests the other AUTOVON party to go secure.

   2. If the calling AUTOVON party has a half-duplex terminal, he states that he will go secure.

   3. The process of going secure will amount to pushing a Go Secure button. This immediately closes the secure relay and lights the Secure indicator.

c. The action of going secure will cause the terminals at both ends to train automatically and upon completion of training, the Ready light will light on the phone or operator console to indicate

that the circuit is ready for secure traffic. The terminal synchronization time should be approximately 4 seconds for full-duplex operation or 8 seconds for half-duplex operation.

d. If one or both of the terminals are half-duplex (push-to-talk), push-to-talk procedures must be followed (over, out, etc.). The synchronization time for push-to-talk operation should be a small fraction of a second. The switchover between transmit and receive in this case may be controlled by:

1. The push-to-talk for a half-duplex narrowband terminal and its distant end.

2. Input receive level for a full-duplex narrowband modem or a SECORD/SEVAC terminal.

3. Radio squelch logic state or equivalent for the radio interface terminal.

e. The terminals are disconnected and returned to clear mode by:

1. Hanging up the phone for narrowband terminals (or depressing a Clear button).

2. Disconnecting the patches and depressing a clear button or switch in the cases involving an operator.

5.6 Automatic Terminal Training

The sequence of events involved in the automatic synchronization of two terminals is as follows:

a. The procedure for going secure guarantees that if a half-duplex terminal is involved in a call with a full-duplex terminal, the half-duplex end will identify its presence during the process of going secure.

b. The secure button, switch, or key, when depressed, will cause the terminal to switch from bypass to online and cause the modem to initiate its training sequence. The first portion of this sequence will be a tone burst for less than 1 second in duration which will be at a 900 Hz frequency if the terminal is half duplex and at 1800 Hz if the terminal is full duplex.

c. The other terminal will monitor the line and automatically switch itself from the bypass to online modem upon recognition of either type of tone burst. If it recognizes 900 Hz, it sets itself for half-duplex operation. If it recognizes 1800 Hz, it sets itself for full-duplex operation (if it is a full-duplex terminal).

d. In the half-duplex operation mode, the modem waits until its receiver is trained to turn its transmitter on to return training. In the full-duplex operation mode, the modem returns training immediately.

e. If a full-duplex terminal is operating in a half-duplex mode, after completion of training it will turn its transmitter on whenever the received signal level is below a prescribed threshold.

f. In all cases, the Ready light is lit after the modem has completed both transmit and receive training.

g. The signal which switches the terminal back to the bypass mode and extinguishes the secure light will be either a signal supplied from the telephone hookswitch (indicating on hook) or a signal from a manual switch or button which may appear on an operator's console.

6.0 INSTALLATION CRITERIA

6.1 Full-Duplex Subscriber Terminal

This mode is designed to accommodate the four-wire subscriber terminal usage of the terminal. It requires two KY-58's and four-wire service to a narrowband system.

As shown in Figure 6.1, the handset provides and receives a signal from the RED/BLACK box through P2J2 and in the clear mode transfers that signal on through J3P3, J4P4, P11J11 and either P8 or P9 going through J1 or J2 out through the transmit/receive terminals on the 16 KB/S modem interface terminals. Since the on hook/off hook sensor operates in conjunction with, rather than replacing, the telephone hook switch, it has no effect in this mode.

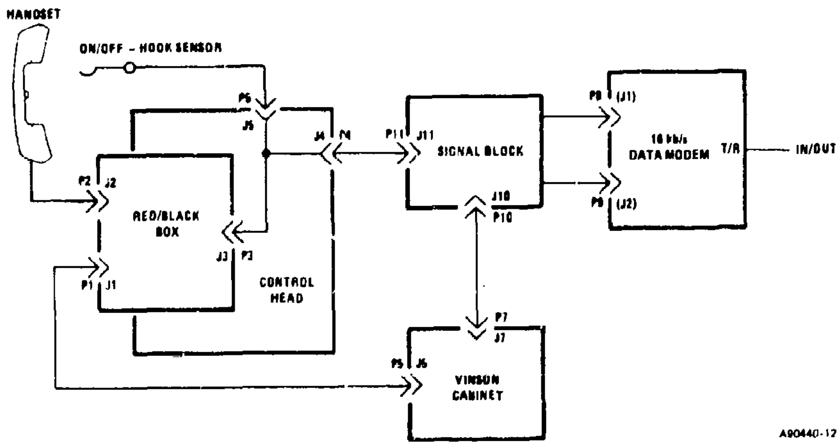


Figure 6.1. Full-Duplex Subscriber Terminal

In the secure mode, the signal is provided through P2J2 to P1J1 to P5J5 in the VINSON CABINET and from there to the KY-58's. The BLACK digitized and encrypted signal is then passed from P7J7 to J10P10 to the P8P9/J1J2 connection on the 16 KB/S modem where it is then converted to a narrowband analog stream still appearing on the input/output terminals. The return path for each of these modes remains the same.

The control signals pass through the RED/BLACK box at the P3J3 connector and are supplemented with the on hook/off hook sensor signals on P5J5 and these appear on the signal block with the J4P4 and P11J11 connections and travel into the 16 KB/S modem where they interface with the control logic card which has been added.

6.2 Half-Duplex Subscriber Terminal

The half-duplex subscriber terminal has a similar signal path to that employed in the full-duplex subscriber terminal in Paragraph 6.1 but relies upon only a two-wire connection. The greatest difference is the presence of only one KY-58 in the VINSON CABINET. The signal paths remain the same, as shown in Figure 6.2.

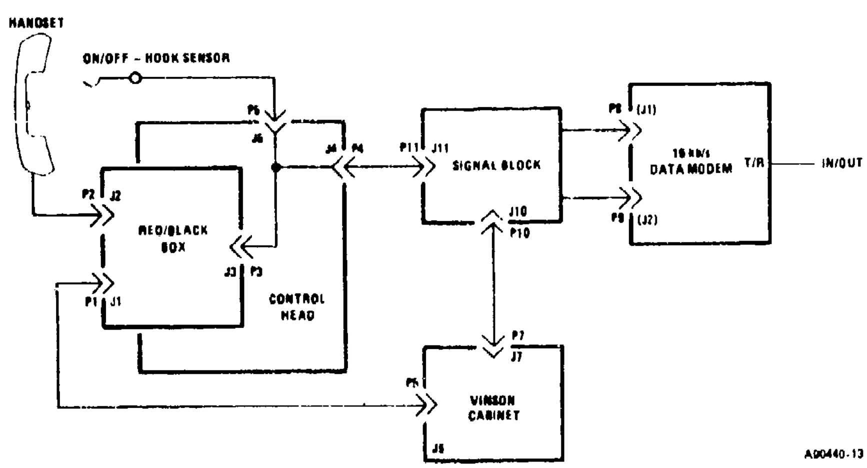


Figure 6.2. Half-Duplex Subscriber Terminal

The control functions are slightly more complex since there is switching involved in the half-duplex mode in contrast to the full-duplex mode where the equipment is left on simultaneously and continuously for receive and transmit. The only changes required outside of the 16 KB/S modem to accommodate a change from full-duplex to half-duplex is the switching of the two-wire/four-wire switches associated with the VINSON CABINET. One of these switches is mounted within the VINSON CABINET and the other is mounted on the rear panel.

The 16 KB/S modem requires two switch changes. They are shown on Figure 6.2 and involve switching the rearmost switch in a dip switch on board A1 (loop board) and the front two switches on the control logic card, A7.

6.3 SECORD/SEVAC Network Translator

The network translator (Figure 6.3) is used to supplement the service in the present AUTOSEVOCOM network. It is a full-duplex installation and differs from the full-duplex subscriber terminal in the following ways:

a. Audio is connected to the RED/BLACK box through leads going to another piece of equipment instead of handset.

b. The on hook/off hook sensor is not used.

c. Connection to P6J6 on the CONTROL HEAD is provided so that the narrowband network lines may be used for other equipment with narrowband capability. Connection P6J6 on the CONTROL HEAD goes to a switch routing the narrowband terminals from the network to either the terminal or to the existing narrowband terminal equipment and all of this is contained within the cable shown running to P6J6 from the input/output terminals. The signal paths are the same as those in the full-duplex subscriber terminal described in Paragraph 6.1.

6.4 The Radio Wire Integration Terminal

The RWI terminal is a half-duplex terminal with two KY-58's. It is used to provide mobile secure communications through a radio link to another terminal. It is possible for a tactical communicator to speak to a distant terminal using this arrangement.

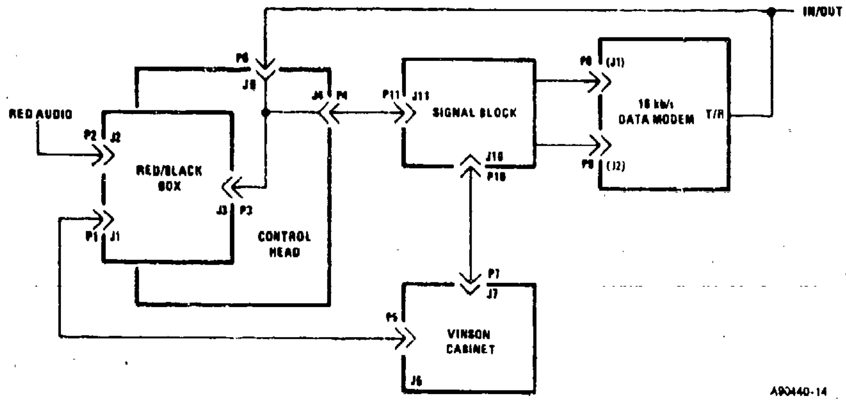


Figure 6.3. SECORD/SEVAC Network Translator

The signal path shown in Figure 6.4 is identical to that described in the half-duplex subscriber terminal. The second KY-58 is used only to sense the presence of encrypted data from the radio terminal. This sensing controls the transmit/receive mode of this entire terminal and no special wiring is required of P10 or P7 or the VINSON CABINET or the signal block to accommodate this mode since a front panel switch allows the terminal operator to speak to the other terminal, to the mobile radio terminal, or to patch both of them together.

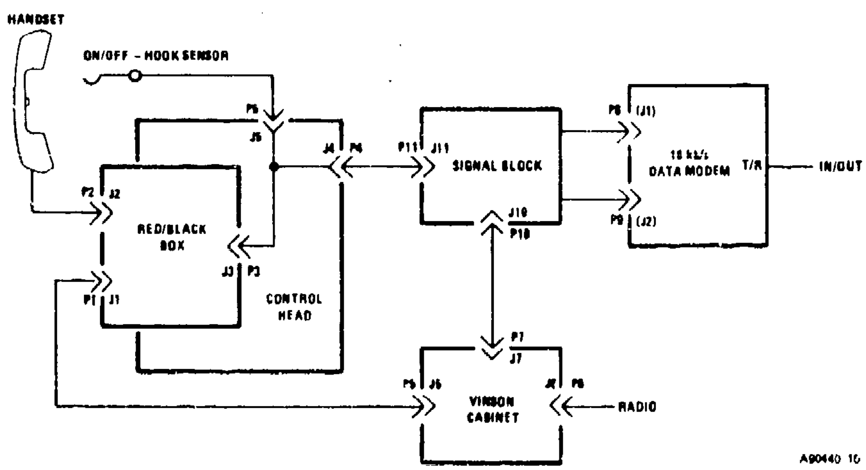


Figure 6.4. RWI (Radio Wire Integration) Terminal

APPENDIX A

ACCEPTANCE TEST PROCEDURE

ACCEPTANCE TEST PROCEDURE

FOR THE

VINSON/AUTOVON TERMINAL

12 NOVEMBER 1979

CONTRACT F30602-79-C-0273

Prepared By: D. O'Quinn

Approved By: W. D. Bilson

FOREWORD

This document provides the Acceptance Test Procedure to be used to demonstrate the full capability of a VINSON/AUTOVON Terminal.

REVISION RECORD

DOCUMENT TITLE: Acceptance Test Procedure for the VINSON/AUTOVON Terminal

DOCUMENT NUMBER: 13044

Revision Letter	Date	Pages Affected	Authority

APPLICABLE DOCUMENTS

Technical Proposal For VINSON/AUTOVON Interface Applique, submitted to Rome Air Development Center in response to F30602-79-C-0273 dated 23 April 1979.

Preparation and Control of Acceptance Test Specifications, Harris Corporation Electronic Systems Division Engineering Standard 900245G, revised 5 March 1976.

Categories of Special Tools and Test Equipment, Harris Corporation Electronic Systems Division Engineering Standard 900295A, revised 30 October 1973.

TABLE OF CONTENTS

1.0 GENERAL

The VINSON/AUTOVON Terminal is a secure voice terminal suitable for placing classified government and military traffic onto an AUTOVON-compatible system. It allows voice recognition and authentication. It is comprised of a special handset, a control head containing a TEMPEST-qualified RED/BLACK switching box, a cabinet with an integral power supply containing one or two Vinson cryptographic devices, and a modified Harris model 5238 high-speed, adaptively equalized, automatic 16 kilobit per second data modem.

This terminal has been designed primarily for providing a secure voice capability to any AUTOVON instrument. It can be also used in any situation requiring the conversion between a red audio interface and an encrypted, narrowband data stream. This additional capability enables this terminal to perform a translation function between a switching network embodying these terminals, and dedicated systems (e.g., AUTOSEVCOM, special airborne networks, and other dedicated or special networks).

The VINSON/AUTOVON Terminal contains common pieces of equipment used in either the end instrument or translation function. This common complement includes a specific type of control head containing the RED/BLACK switching box, the Vinson cabinet, and a signal block assembly located with the 16 kilobit data modem.

As a secure voice end terminal, the equipment includes a push-to-talk handset connected to a desk-top control head on which the telephone instrument rests. An on-hook sensor, which is also connected to the control head, is added to the telephone cradle. This arrangement, embodying a different style operator's control head, is also used for the radio/wire integration system.

The translation function does not require either the on-hook sensor or the push-to-talk handset. In these installations the RED/BLACK switching box may be removed from the operator's control head and placed with the Vinson cabinet in an equipment vault. This permits the operator's area (e.g., SECORD position) to remain an unsecure area while all of the red signal processing equipment remains in a secure area.

2.0 TEST DESCRIPTIONS

There are four modes of operation using the VINSON/AUTOVON Terminal. Each mode assumes certain characteristics peculiar to that mode and generates different test requirements described in the following sections. Any Vinson may be removed, replaced, or inserted in any cabinet at any time if the power to the involved cabinet is switched off at the time the cables are connected to or disconnected from the Vinson.

Two of the modes are used when the terminal provides secure voice capability to an AUTOVON subscriber. The terminal is configured for full-duplex operation if four-wire service and two KY-58's are available. Otherwise, the terminal is configured for half-duplex service, which requires only one Vinson. Thorough testing is required for each of these modes.

The SECORD/SEVAC/Special Network translation mode and the Radio Wire Integration mode each requires two Vinsons for proper operation. If the previous two modes have been tested, then only the special control functions will require testing in these two modes.

3.0 TEST PROCEDURES

The objective of this Acceptance Test Procedure is to demonstrate that the VINSON/AUTOVON Terminal is capable of being operated in the four modes described in Section 2.0. All components of an entire system may be

tested with Section 3.5 simultaneously, if two complete systems are available. Otherwise, the functional area tests may be employed to verify capability without other functional area components available. The appropriate sections of the Acceptance Test Data Sheets in Appendix A will be used in either case to record specific data.

3.1 Handset and Sensor Functional Area

3.1.1 Equipment Required

a. Handset(s) to be tested

b. Sensor(s) to be tested

c. Simpson 630 multimeter or equivalent

3.1.2 Test Description

Measure the values of resistance found on the headset and sensor terminals for certain states using the X100 position of the multimeter.

3.1.3 Test Performance

a. Measure the following pins for the indicated resistances: P2-1 : P2-9 (100-500 ohms), P2-2 : P2-3 (150-450 ohms) and P2-7 : P2-8 (o.c., open circuit). Depress and hold the push-to-talk button. Remeasure P2-7 : P2-8 (s.c., short circuit). Release the button.

b. Observe that there are only two leads associated with the onhook/offhook sensor. Test the continuity between the leads (P5-3 : P5-4, if installed onto a plug) associated with onhook and the offhook positions of the sensing arm to verify that the offhook position yields an o.c. (open circuit) and the onhook position yields an s.c. (short circuit).

3.2 RED/BLACK Box Functional Area

3.2.1 Equipment Required:

a. RED/BLACK box(es) to be tested.

b. Simpson 630 multimeter or equivalent.

c. Battery or power supply capable of furnishing a voltage of 5 ± 1 volts dc for relay voltage.

d. Test Plug P1 - ITT Cannon DEMM-9P (or equivalent 9 pin plug) with leads attached as specified on T-16332 to test static conditions.

e. Test Plug P2 - ITT Cannon DEMM-9S (or equivalent 9 pin plug) with leads attached to test static conditions.

f. Test Plug P3 - Amphenol 57-20240 plug (or equivalent 24 pin plug) with leads attached as specified on T-16332 for applying voltages to test static conditions.

g. A nominal 1,000 ohm resistor, measuring 750 to 1300 ohms.

3.2.2 Test Description

Test that the correct signal paths exist for the various functions of this box.

3.2.3 Test Performance

a. Connect the relay voltage for the duration of 3.2.3 (negative to J3-11, positive to J3-7). Momentarily ground the lead from J3-20 (Latch Clear) to J3-11 (Signal Ground). Test the following pin combinations for the resistance indicated:

Combination	Indication
J2-1 : J3-16	s.c.
J2-9 : J3-15	s.c.
J2-2 : J3-17	s.c.
J2-3 : J3-18	s.c.
J2-4 : J1-1	s.c.
J2-4 : J3-11	o.c.
J3-9 : J3-11	s.c.
J3-21 : J3-11	o.c.

b. Momentarily ground the lead from J3-10 (Latch Secure) to J3-11 (Signal Ground). Test the following pin connections for resistance:

Connections	Indication
J2-1 : J3-16	o.c.
J2-9 : J3-15	o.c.
J2-1 : J1-1	s.c.
J2-9 : J1-1	s.c.
J2-4 : J3-11	o.c.

c. Ground the lead from J3-22 (Secure Relays Keying) to J3-11 (Signal Ground) for the remainder of 3.2.3. Test the following pin connections for resistance:

Connections	Indications
J2-1 : J1-5	s.c.
J2-9 : J1-9	s.c.
J2-2 : J1-2	s.c.

J2-3 : J1-3	s.c.
J2-4 : J3-11	o.c.
J2-7 : J1-7	s.c.
J2-8 : J1-8	s.c.
J3-21 : J3-11	s.c.

d. Connect a negative lead from the power source to J1-8. Connect one end of the 1,000 ohm resistor to a positive lead from the power source, and connect the other end to J1-7. Set the multimeter to the 10 volt scale and connect the negative probe to the negative lead of the relay voltage supply. Connect the positive probe to J3-6 (Push-to-Talk Sensing). Verify that this voltage is less than 0.5 volt. Ground the lead from J3-5 (Phone Patch Keying) to J3-11 (Signal Ground) until the voltage on J3-6 (Push-to-Talk Sensing) has been read, which should be more than 3 volts. Short J2-7 to J2-8 until the voltage on J3-6 (Push-to-Talk Sensing) has been read, which should be more than 3 volts.

3.3 Control Head Functional Area

3.3.1 Equipment Required:

a. Control Head(s) to be tested.

b. Simpson 630 multimeter or equivalent.

c. Battery or power supply capable of furnishing approximately 5 volts.

d. Test Plug P4 - Amphenol 57-10500-7 (or equivalent 50 pin plug) with leads attached as specified on T-16332 to test static conditions.

3.3.2 Test Description

Ascertain that all switches and indicators function properly.

3.3.3 Test Performance

a. Connect the positive lead of the power source to J4-8 (+5 volts - LED's). Connect the negative lead to each of the following pins and verify that the associated LED operates.

J4-19 - Yellow LED - "XMIT"

J4-23 - Yellow LED - "REC"

J4-24 - Yellow LED - "USE PTT"

J4-25 - Green LED - "READY"

J4-26 - Green LED - "SECURE"

J4-27 - Red LED - "CLEAR"

Disconnect the power source.

b. Test the continuity in the two pushbutton circuits as indicated. Depressing the "GO SEC" (or "GO SECURE") switch should close the

circuit between J4-32 and J4-29. Oepressing the "GO CLR" (or "GO CLEAR") switch should close the circuit between J4-32 and J4-28.

c. Test for the indicated continuity (s.c.) between the following pins:

Combination	Indication
J4-37 : J4-39	s.c.
J4-42 : J4-40	s.c.
J4-44 : J4-46	s.c.
J4-49 : J4-47	s.c.

d. Connect the positive leads of the power source to J4-50 (+5 volts - Line Select Relays), and connect the negative lead to J4-43 (Line Select Relays Drive). Test for the indicated continuity (s.c.) between the following pins:

Combination	Indication
J4-37 : J4-38	s.c.
J4-42 : J4-41	s.c.

J4-44 : J4-45	s.c.
J4-49 : J4-48	s.c.

Disconnect the power source.

e. If the control head has an "RWI" switch, perform the tests in this paragraph. Test for the indicated continuity (s.c.) from J4-36 (RWI) to the pin associated with each mode as it is selected:

Pin and Mode	Indication
J4-33 ("PATCH")	s.c.
J4-34 ("RADIO")	s.c.
J4-35 ("TEL")	s.c.

f. If the control head has a "TERM SELECT" switch, then test for the indicated continuity between the following terminals with the pointer in the "VINSON" position:

Combination	Indication
J6-1 : J6-2	s.c.

J6-4 : J6-5	s.c.
J6-7 : J6-8	s.c.
J6-10 : J6-11	s.c.
J6-1 : J6-3	o.c.
J6-4 : J6-6	o.c.
J6-7 : J6-9	o.c.
J6-10 : J6-12	o.c.

Move the pointer from "VINSON" to "ALT" and then test for the indicated continuity (s.c.) between the following terminals:

Combination	Indication
J6-1 : J6-3	s.c.
J6-4 : J6-6	s.c.
J6-7 : J6-9	s.c.

J6-10 : J6-12	s.c.
J6-1 : J6-2	o.c.
J6-4 : J6-5	o.c.
J6-7 : J6-8	o.c.
J6-10 : J6-11	o.c.

g. Verify the continuity (s.c.) between the specified points on each line:

J3-1 : J4-1

J3-2 : J4-2

J4-3 : J5-3

J4-4 : J5-4

J3-5 : J4-5

J3-6 : J4-6

J3-7 : J4-7

J3-9 : J4-9

J3-10 : J4-10

J3-11 : J4-11

J3-15 : J4-15 : J5-8

J3-16 : J4-16 : J5-9

J3-17 : J4-17 : J5-10

J3-18 : J4-18 : J5-11

J3-20 : J4-20

J3-21 : J4-21

J3-22 : J4-22

3.4 Vinson Cabinet Functional Area

3.4.1 Equipment Required:

a. Vinson Cabinet(s) to be tested.

b. Simpson 630 Multimeter or equivalent.

c. Battery or power supply capable of furnishing a voltage of 5 ±1 volts dc for relay voltage.

3.4.2 Test Description

Verify that the Vinson Cabinet circuitry will perform properly with the external interfaces.

3.4.3 Test Performance

Note: References are made to P1A, P2A, P1B, and P2B. J1 and J2 are two marked male receptacles on the rear of each Vinson device. P1 and P2 are the associated plugs for each box. The suffix "A" refers to cables connected to the left one on the front panel, and the suffix "B" refers to cables connected to the right one on the front panel. Do not connect primary power until the step is indicated.

a. Compare the resistance measured between the following points with the value indicated: J5-2:P2A-K (180-220 ohms), J5-2:P2B-K (180-220 ohms), and P2A-K:P2B-K (350-450 ohms).

b. Set the multimeter to read the power source voltage. Connect the negative terminal of the power source J5-8. Connect the positive probe of the multimeter to the positive lead of the power source. Place the "OPERATE/LOAD" switch into the "LOAD" position. Read the voltage on P2A-P with the negative probe before and while depressing the "XMIT KEYING" switch. Read the voltage on P2B-P with the negative probe before and while depressing the "XMIT KEYING". The voltage on each point shall be absent until the button is depressed, and then rise to over 3 volts.

c. Place the "OPERATE/LOAD" switch into the "OPERATE" position. Set the "4W/2W" switch on the back of the front panel to "2W". Measure the resistance between J5-8:J2A-F and also J5-8:J2A-P. Change the "4W/2W" switch to "4W". Measure the resistance J5-8:J2A-P.

d. Set the "2W/4W" switch on the back of the cabinet's rear panel to the "2W" position. Test the continuity for J7-22:J1-A-b (s.c.) and J7-22:J1B-b (o.c.). Reverse the position of the "2W/4W"

switch on the back of the cabinet's rear panel. Retest the continuity for J7-22:J1A-b (o.c.) and J7-22:J1B-b (s.c.).

e. Compare the following resistance values with the indicated values:

Measurement	Indication
J1A-E : J6-7	450-700 ohms
J1A-E : J1A-T	650-1600 ohms
J1A-T: J6-15	s.c.
J1A-T : J6-3	s.c.
J7-1 : J7-15	o.c.

f. Connect the primary power; turn on the Vinson Cabinet power switch and measure the following voltages on the 50 volt scale:

Measurement	Indication
J1A-K : J1A-H	28 $\pm$2 Vdc
J1A-K : J1A-L	28 $\pm$2 Vdc
J1B-K : J1B-H	28 $\pm$2 Vdc
J1B-K : J1B-L	28 $\pm$2 Vdc

Disconnect all leads and the primary power.

3.5 Terminal Functional Test

3.5.1 Equipment Required

a. Two VINSON/AUTOVON Terminals, with necessary cryptographic devices and materials. (Note: It is preferable to start the checkout procedures with both terminals configured as normal desk-top VINSON/AUTOVON Terminals. The black subscriber control head can be used only in terminal functional tests through 3.5.4.3. If a sloping front control head is to be used for the remainder of the terminal functional tests, it should have also been tested in the earlier terminal functional test steps. The TERM SELECT should always select the VINSON position and the RWI switch should always select TEL except on those occasions when the sloping front control is used in a terminal for other purposes.)

b. For the RWI terminal mode. An external signal from a KY-58 which is loaded with a valid key. (This signal may be from a local KY-58 if available, remote from another terminal, or simulated if a KY-58 simulator is available.)

c. Simpson 630 multimeter or equivalent.

3.5.2 Configuration Descriptions

a. Full-duplex subscriber terminal: This terminal is comprised of a push-to-talk handset, an onhook/offhook sensor, a black subscriber control head designed to fit under a telephone (embodying a RED/BLACK switching box), a Vinson Cabinet which is equipped with two KY-58's, and a modified Harris 5238 16 KB/S data modem.

b. Half-duplex subscriber terminal: This terminal is physically identical to the full-duplex subscriber terminal except that the Vinson Cabinet is equipped with only one KY-58. Electrical differences between these two configurations are described in 3.5.4.c.

c. SECORD/SEVAC Network Translator: This terminal is comprised of a sloping front control head slightly larger than a desk telephone, a Vinson Cabinet equipped with two KY-58's, and a modified Harris 5238 16 kilobit data modem.

d. RWI (Radio Wire Integration) Terminal: This terminal is comprised of a push-to-talk handset, an on-hook/off-hook sensor, a sloping front control head slightly larger than a desk telephone, a Vinson Cabinet equipped with two KY-58's, and a modified Harris 5238 16 kilobit data modem.

3.5.3 Test Description

Test the four operational configurations for proper functioning of the equipment.

3.5.4 Test Performance

a. Connect all units and apply power. A warm-up period of fifteen minutes is desirable, but it is not necessary. (If only one KY-58 is available for a terminal, it must be installed in the left position of the Vinson Cabinet.)

b. Load the cryptodevices using the VINSON/AUTOVON Terminal Modified Vinson Loading Instructions:

1. Power-ON (three switches)

2. Volume (both) - mid-range

3. Position (both) -1 unless otherwise needed

4. Mode (both) - C

5. Operate/Load - LOAD

6. XMIT KEYING - Press to clear alarms (constant or intermittent tones)

NOTE: Steps 7-16 refer to unit being filled.

7. Mode-C of unit being filled

8. Mode-P of other unit

9. Connect KOI-18 or other fill source.

10. Select position to be filled (as in third instruction).

11. Insert tape leader into KOI-18 slot marked IN, lining up feed holes with white dots on device.

12. Mode: Change from C to LD.

13. Press XMIT KEYING to clear tone.

14. Pull tape through KOI-18 tape reader at a steady rate. A single beep indicates that the load was successful; if this beep is not observed, repeat the load process.

15. Mode: Change from LD to C, other unit change from p to c.

16. Disconnect key source.

17. Repeat steps 7 through 16 for a second unit.

18. Mode-C on both units.

19. Return Operate/Load switch to OPERATE, and press the "GO CLR" (or "GO CLEAR") switch.

c. There are four locations which require changes when transferring between FDX (full-duplex) and HDX (half-duplex) operation. This is without regard to the type of control head employed or the application of the terminal. It will be necessary, therefore, to return to this section in the following tests in order to make these changes. Switch positions on the loop and control cards are shown on Diagram 3.5.4.c).

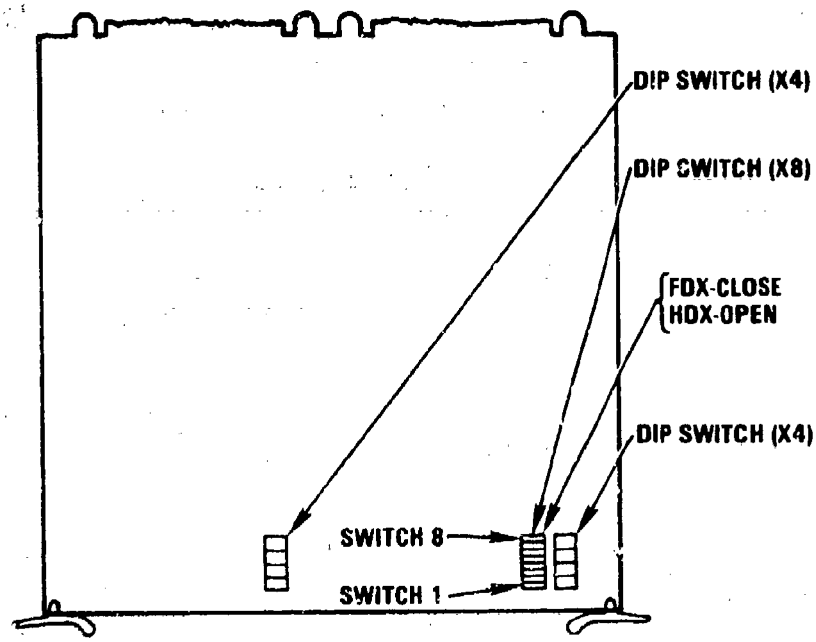
1. For FDX operation:

   (a) Place the switch behind the front panel in "4W" position.

   (b) Place the switch on the rear panel of the Vinson Cabinet in the "4W" position.

TOP VIEW:
LOOP BOARD (A1)

TO CLOSE A SWITCH, PRESS DOWN ON THE TAB ON THE EDGE MARKED WITH A "+" OR THE WORD "ON". TO OPEN A SWITCH, PRESS DOWN ON THE TAB ON THE OPPOSITE EDGE.



TOP VIEW:
CONTROL LOGIC CARD (A7)

TO CLOSE A SWITCH, PRESS DOWN ON THE EDGE MARKED WITH A "+" OR THE WORD "ON". TO OPEN A SWITCH, PRESS DOWN ON THE TAB ON THE OPPOSITE EDGE.

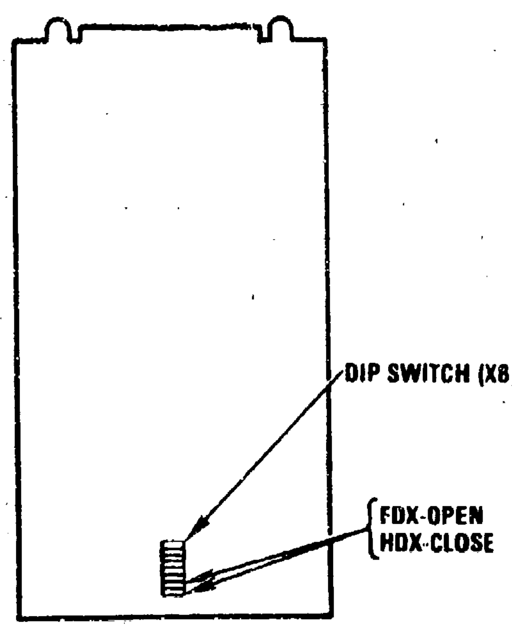


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Diagram 3.5.4.c. Test Performance Full-Duplex/Half-Duplex Changeover

(c) Open the contacts for control card switches 7 and 8 (adjacent to the front edge) of the dip switch located on the front edge in modem card slot A7.

(d) Close switch 8 on the loop board. (This is at the inside end of the middle switch of the card in modem card slot A1.)

2. For HDX operation:

(a) Place the switch behind the front panel in the "2W" position.

(b) Place the switch on the rear panel of the Vinson cabinet in the "2W" position.

(c) Close the contacts for control card switches 7 and 8 (adjacent to the front edge) of the dip switch located on the front edge in modem card slot A7.

(d) Open switch 8 on the loop board. (This is at the inside end of the middle switch of the card in modem card slot A1.)

d. Test Procedure for FDX End Terminals

Note: While these terminals are capable of communicating between those configured for HDX and FDX, this testing calls for HOX with HDX and FDX with FDX to identify the results of each test step.

1. Initialize both ends by lifting and replacing the push-to-talk handsets on the on-hook/off-hook sensors. Only the red "CLEAR" LED on each control head should be lit.

2. Remove handsets from the sensors. There should be no change in status lights.

3. Initiate the start-up process by depressing the "GO SEC" button on one control head. The "CLEAR" LED's should be extinguished immediately, and should be replaced by a lit yellow "XMIT" LED, a lit yellow "REC" LED, and a lit green "SECURE" LED on each control head.

4. Within approximately fifteen seconds, the green "READY" LED should light on each control head.

5. Speech should pass from the initiating handset to the called handset without either end depressing the push-to-talk switch.

6. Speech should pass from the called handset to the initiating handset without either end depressing the push-to-talk switch.

7. Each end may independently terminate the call by replacing the handset onto the on-hook/off-hook sensor. All previously lit lights should extinguish and the red "CLEAR" LED should come on at each end when the local handset is replaced.

e. Test Procedure for HDX End Terminals

Note: While these terminals are capable of communicating between those configured HDX and FDX, this testing calls for HDX with HDX and FDX with FDX to identify the results of each test step.

1. Initialize both ends by lifting and replacing the push-to-talk handsets on the on-hook/off-hook sensors. Only the red "CLEAR" LED on each control head should be lit.

2. Remote the handsets from the sensors. There should be no change in the status lights.

3. Initiate the start-up process by depressing "GO SEC" button on one control head. The "CLEAR" LED's should be extinguished immediately, and should be replaced by a lit yellow "USE PTT" LED and a lit green "SECURE" LED.

   Additionally, the initiating terminal should first display a lit yellow "XMIT" LED, followed by a lit yellow "REC" LED. The called terminal control head should simultaneously display the converse indications.

4. Within approximately fifteen seconds, all lamps should be extinguished except a green "READY" LED, a green "SECURE" LED, and a yellow "USE PTT" LED.

5. When the initiating handset push-to-talk button is depressed, the "XMIT" LED should light on the initiating control head, the "REC" LED should light on the called control head, and speech should pass from the initiating handset to the called handset.

6. When the called handset push-to-talk button is depressed, the "XMIT" LED should light on the called control head, the "REC" LED should light on the initiating control head, and speech should pass from the called handset to the initiating handset.

7. Each end may independently terminate the call by replacing the handset onto the on-hook/off-hook sensor. All previously lit lights should extinguish and the red "CLEAR" LED should come on at each end when the local handset is replaced.

f. Test Procedure for Network Translators

Note: This is an FDX configuration without a handset or on-hook/off-hook sensor. If a unit, including the special control head, has been tested as an FDX end terminal, then the only testing required is that of the special control functions, as outlined below.

1. Place the "TERM SELECT" switch in the "VINSON" position and the "RWI" switch in "TEL" position.

2. Initiate secure communications by pushing the "GO SECURE" button.

3. After the "READY" light has lit, push the "GO CLEAR" button. Only the "CLEAR" LED should be lit.

g. Test Procedure for RWI Terminals

Note: This is a HDX configuration. If a unit, including the special control head, has been tested as a HDX end terminal, then the only testing required is that of the special control functions, as outlined below. Otherwise, the unit should be tested as an HDX end terminal first.

1. Verify the "TERM SELECT" switch is in the "VINSON" position, and the "RWI" switch is in the TEL position.

2. Press the "GO SECURE" button. Wait approximately 30 seconds. Press the "GO CLEAR" button.

3. Verify continuity (s.c.) between J1A-Z and J7-5.

4. Verify continuity (s.c.) between J1B-Z and J7-6.

APPENDIX A

ACCEPTANCE TEST DATA SHEETS

VINSON/AUTOVON TERMINAL

12 November 1979

Contract F30602-79-C-0273

APPENDIX A

TEST PACKAGE

This section provides a checklist for a "go/no-go" decision regarding each test performed in Section 3 of ATP 13044. The numbering following 4.2 directly corresponds to the step in Section 3 in which the data is collected.

A.1 Test and Auxillary Equipment Required or Tested

A.1.1 Test Equipment

Manufacturer	Model	Nomenclature	Serial Number	Calibration
Simpson	630	Multimeter	________	________
		1000 ohm resistor measuring 750 to 1300 ohms on multimeter	None	NCR
Harris	T-16332	Tool Set (Plug Set) Category B-2		NCR
Power Design	6150	Universal DC Power Source	________	________

A.2 Collection of Data

All test data can be collected by checking off the adjacent block if the measured value agrees with the expected value. Otherwise, the observed value may be enetered for later analysis. Unless specified otherwise, measurements have a $\pm$20% tolerance.

Many of the tests require only that a determination of continuity or an open circuit be established. Continuity (or a short-circuit, "s.c.") is defined as less than 2 ohms. An open circuit, "o.c." is defined as more than 100,000 ohms within 30 seconds.

A.3 Tests and Measurements

A.3.1 Headset and Sensor Function Area

A.3.1.3.a P2-2:P2-3 exhibits 300 $\pm$150 ohms resistance. ____________

P2-7:P2-8 exhibits an open circuit. ____________

P2-1:P2-9 exhibits 100 to 500 ohms resistance. ____________

Re-measuring P2-7:P2-8 with the push-to talk button depressed shows a short-circuit. ____________

A.3.1.3.b An o.c. (open-circuit) is observed in the off-hook position.

An s.c. (short-circuit) is observed in the on-hook position.

A.3.2.3.a)

Condition	Measurement	Indication	Result
None	J2-1 : J3-16	S.C.	________
"	J2-9 : J3-15	S.C.	________
"	J2-2 : J3-17	S.C.	________
"	J2-3 : J3-18	S.C.	________
"	J2-4 : J1-1	S.C.	________
"	J2-4 : J3-11	O.C.	________
"	J3-9 : J3-11	S.C.	________
"	J3-21 : J3-11	O.C.	________

A.3.2.3.b)

Condition	Measurement	Indication	Result
None	J2-1 : J3-16	O.C.	________
"	J2-9 : J3-15	O.C.	________
"	J2-1 : J1-1	S.C.	________
"	J2-9 : J1-1	S.C	________
"	J2-4 : J3-11	O.C.	________

A.3.2.3.c)

Condition	Measurement	Indication	Result
"	J2-1 : J1-5	S.C.	________
"	J2-9 : J1-9	S.C.	________
"	J2-2 : J1-2	S.C.	________
"	J2-3 : J1-3	S.C.	________
"	J2-4 : J3-11	O.C.	________
"	J2-7 : J1-7	S.C.	________
"	J2-8 : J1-8	S.C.	________
"	J3-21 : J3-11	S.C.	________

A.3.2.3.d)

Condition	Measurement	Indication	Result
Normal	J3-6	Less than .5 volt	________
J3-5 grounded	J3-6	More than 3 volts	________
J2-7 tied to J2-8	J3-6	More than 3 volts	________

A.3.3 Control Head Functional Area

A.3.3.3.a)

Condition	Measurement	Indication	Result
J4-19	None	yellow "XMIT" lights	________
J4-23	None	yellow "REC" lights	________
J4-24	None	yellow "USE PTT" lights	________
J4-25	None	green "READY" lights	________
J4-26	None	green "SECURE" lights	________
J4-27	None	red "CLEAR" lights	________

A.3.3.3.b)

Condition	Measurement	Indication	Result
Go SEC(URE) normal	J4-32 : J4-29	O.C.	________
Go SEC(URE) depressed	J4-32 : J4-29	S.C.	________
Go CL(EA)R normal	J4-32 : J4-28	O.C.	________
Go CL(EA)R depressed	J4-32 : J4-28	S.C.	________

A.3.3.3.c)

Condition	Measurement	Indication	Result
	J4-37 : J4-39	S.C.	________
	J4-42 : J4-40	S.C.	________
	J4-44 : J4-46	S.C.	________
	J4-49 : J4-47	S.C.	________

A.3.3.3.d)

Condition	Measurement	Indication	Result
	J4-37 : J4-38	S.C.	________
	J4-42 : J4-41	S.C.	________
	J4-44 : J4-45	S.C.	________
	J4-49 : J4-48	S.C.	________

A.3.3.3.e) Does this control head have an RWI switch? YES ____ NO ____

Condition	Measurement	Indication	Result
PATCH selected	J4-36 : J4-33	S.C.	________
RADIO selected	J4-36 : J4-34	S.C.	________
TEL selected	J4-36 : J4-35	S.C.	________

A.3.3.3.f) Does this control head have a TERM SELECT switch? YES ____ NO ____

Condition	Measurement	Indication	Result
TERM SELECT-VINSON	J6-1 : J6-2	S.C.	________
"	J6-4 : J6-5	S.C.	________
"	J6-7 : J6-8	S.C.	________
"	J6-10 : J6-11	S.C.	________
"	J6-1 : J6-3	O.C.	________
"	J6-4 : J6-6	O.C.	________
"	J6-7 : J6-9	O.C.	________
"	J6-10 : J6-12	O.C.	________
TERM SELECT-ALT	J6-1 : J6-3	S.C.	________
"	J6-4 : J6-6	S.C.	________
"	J6-7 : J6-9	S.C.	________
"	J6-10 : J6-12	S.C.	________
"	J6-1 : J6-2	O.C.	________

Condition	Measurement	Indication	Result
TERM SELECT-ALT	J6-4 : J6-5	O.C.	________
"	J6-7 : J6-8	O.C.	________
"	J6-10 : J6-11	O.C.	________

A.3.3.3.g)

Condition	Measurement	Indication	Result
None	J3-1 : J4-1	S.C.	________
"	J3-2 : J4-2	S.C.	________
"	J4-3 : J5-3	S.C.	________
"	J4-4 : J5-4	S.C.	________
"	J3-5 : J4-5	S.C.	________
"	J3-6 : J4-6	S.C.	________
"	J3-7 : J4-7	S.C.	________
"	J3-9 : J4-9	S.C.	________
"	J3-10 : J4-10	S.C.	________
"	J3-11 : J4-11	S.C.	________
"	J3-15 : J4-15	S.C.	________
"	(J3-15 : J4-15)		
	: J5-8	S.C.	________
"	J3-16 : J4-16	S.C.	________
"	(J3:16 J4-16)		
	: J5-9	S.C.	________
"	J3-17 : J4-17	S.C.	________
"	(J3-17 : J4-17)		
	: J5-10	S.C.	________
"	J3-18 : J4-18	S.C.	________
"	(J3-18 : J4-18)		
	: J5-11	S.C.	________
"	J3-20 : J4-20	S.C.	________
"	J3-21 : J4-21	S.C.	________
"	J3-22 : J4-22	S.C.	________

A.3.4 Vinson Cabinet Functional Area

A.3.4.3.a)

Condition	Measurement	Indication	Result
None	J5-2 : P2A-K	200 $\pm$20 ohms	________
"	J5-2 : P2B-K	200 $\pm$20 ohms	________
"	P2A-K : P2B-K	400 $\pm$50 ohms	________

A.3.4.3.b)

Condition	Measurement	Indication	Result
XMIT KEYING normal	P2A-P	0 volts	________
XMIT KEYING depressed	P2A-P	more than 3 volts	________
XMIT KEYING normal	P2B-P	0 volts	
XMIT KEYING depressed	P2B-P	more than 3 volts	________

A.3.4.3.c)

Condition	Measurement	Indication	Result
2W	J5-8 : J2A-F	S.C.	________
2W	J5-8 : J2A-P	O.C.	________
4W	J5-8 : J2A-P	S.C.	________

A.3.4.3.d)

Condition	Measurement	Indication	Result
2W	J7-22 : J1A-B	S.C.	________
2W	J7-22 : J1B-B	O.C.	________
4W	J7-22 : J1A-B	O.C.	________
4W	J7-22 : J1B-B	S.C.	________

A.3.4.3.e)

Condition	Measurement	Indication	Result
None	J1A-E : J6-7	450-700 ohms	________
"	J1A-E : J1A-T	650 -1600 ohms	________
"	J1A-T : J6-15	S.C.	________
"	J1A-T : J6-3	S.C.	________
"	J7-1 : J7-15	O.C.	________

A.3.4.3.f)

Condition	Measurement	Indication	Result
Power on	J1A-K : J1A-H	28 $\pm$2 Vdc	________
"	J1A-K : J1A-L	28 $\pm$2 Vdc	________
"	J1B-K : J1B-H	28 $\pm$2 Vdc	________
"	J1B-K : J1B-L	28 $\pm$2 Vdc	________

A.3.5 Terminal Functional Test

Condition	Measurement	Indication	Result
Power on-Modem	None	fan operates	________
Power on-VINSON Cabinet	None	fan operates	________
Cables connected	None	control head SECURE LED is on	________

A.3.5.4.b)

Condition	Measurement	Indication	Result
Before Step 6	None	Noise and beeping are heard in handset	________
After Step 7	None	Noise and beeping disappear	________

Condition	Measurement	Indication	Result
After Step 12	None	Tone is heard	________
After Step 13	None	Tone disappears	________
Step 14	None	Single beep is heard	________

Does this Vinson Cabinet use two KY-58's? YES ____ NO ____

Condition	Indication	Result
(Step 16) After Step 12	Tone is heard	________
(Step 16) After Step 13	Tone disappears	________
(Step 16) Step 14	Single beep is heard	________

A.3.5.4.c) No measurements are performed.

A.3.5.4.d)

Condition	Measurement	Indication	Result
Step 1	None	Red CLEAR LED lights on each control head	________
Step 2	None	No change occurs in status lights	________
Step 3	None	Red CLEAR LED's extinguish.	________
	None	Yellow XMIT LED's light.	________
	None	Yellow REC LED's light.	________
	None	Green SECURE LED's light.	________
Step 4	None	Green READY LED's light.	________
Step 5	None	Initiator speech is communicated without push-to-talk action.	________
Step 6	None	Called speech is	

		communicated without push-to-talk action.	________

Condition	Measurement	Indication	Result
Step 7	None	All lit lights extinguish.	________
	None	Red CLEAR LED lights.	________

A.3.5.4.e)

Condition	Measurement	Indication	Result
Step 1	None	Red CLEAR LED lights on each control head.	________
Step 2	None	No change occurs in status lights.	________
Step 3	None	Yellow USE PTT LED's light.	________
	None	Green SECURE LED's light.	________
	None	Initiating yellow XMIT LED lights.	________
	None	Called yellow REC LED lights.	________
	None	Initiating XMIT LED	________
	None	Called REC LED extinguishes.	________
	None	Initiating yellow REC LED lights.	________

	None	Called XMIT LED extinguishes.	________
Step 4	None	Green READY LED's light	________
	None	Green SECURE LED's light	________
	None	Yellow USE PTT LED lights.	________
Step 5	None	Initiating XMIT LED lights when initiating push-to-talk button is depressed.	________
	None	Called REC LED lights when initiating XMIT LED lights.	________
	None	Initiator speech is communicated when initiating XMIT LED is lit.	________

Condition	Measurement	Indication	Result
Step 6	None	Called XMIT LED lights when called push-to-talk button is depressed.	________
	None	Initiating REC lights when called XMIT LED lights.	________

Condition	Measurement	Indication	Result
	None	Called speech is communicated when called XMIT LED is lit.	________
Step 7	None	All lit lights extinguish.	________
	None	Red Clear LED's light.	________

A.3.5.4.f)

Condition	Measurement	Indication	Result
TERM SELECT VINSON	-	-	-
RWI-TEL	-	-	-
After Step 2	None	READY LED lights within 25 seconds.	________
After Step 3	None	Only CLEAR LED is lit.	________

A.3.5.4.g)

Condition	Measurement	Indication	Result
Step 2 +30 seconds	None	READY and SECURE LED's are lighted.	________
Step 2-after GO CLEAR	None	Only CLEAR LED is lighted.	________
Step 3	J1A-Z:J7-5	s.c.	________
Step 4	J1B-Z:J7-6	s.c.	________

A.4 CERTIFICATION

Date: ___________

I have witnessed the tests on the equipment identified below associated with Red/Black Box 91417-437901-G01 Serial Number _______

Comments:

____
____
____
____
____
____
____
____
____
____
____
____
____
____
____

____
Test Conductor

____
QC Inspector

____
Government Representative

APPENDIX B

EUROPEAN DEMONSTRATION

B.1 INTRODUCTION

This appendix discusses a major demonstration that was performed in Europe over various contingency/crisis transmission media. The demonstration took place during the period of 12-26 January 1980 and was conducted for the European secure voice community. The demonstrations involved fixed and mobile sites in Germany, the United Kingdom and Italy. Several new dimensions were demonstrated in the use of the VINSON/AUTOVON adapter, including conferencing and narrowband tandems.

Table 1 presents the results of the 2-week test program. Since the purpose of the program was to demonstrate the feasibility of the VINSON/AUTOVON adapter terminal, no attempt was made to characterize lines. The performance assessments provided are based on consensus comments by members of the European secure voice community.

This appendix is organized as follows: Paragraph B.1 contains the Introduction and General Information. Paragraph B.2 discusses the configurations and test results in Germany. The Italian setup and results are presented in paragraph B.3. Finally, paragraph B.4 discusses activity in the United Kingdom.

B.2 GERMANY DEMONSTRATION

The demonstrations/tests performed in Germany involved four locations: Heidelberg, Ramstein, Patch Barracks, and Karlshrue. A variety of configurations over various transmission media were tested for each location.

B.2.1 Heidelberg and Ramstein

The majority of the tests performed at Heidelberg and Ramstein involved the terminal configuration shown in Figure B.2.1. This configuration is intended for use with existing phone service. During the

Table 1. European Demonstration Test Results

Location[1]	Configuration	Transmission Media	Calls		Performance	Comments
			Attempted	Complete		
VAI-HBG	Half-Dux	AUTOVON	21	18	Excellent	
VAI-NPS	Half-Dux	AUTOVON	28	20	Good	BER = 0.5% to 1% due to Tropo link from Swartzwald to Mt. Vergine via Mt. Limbarg
VAI-NPS	Half-Dux	AUTOVON	10	10	Excellent	Dedicated Link - Link is via DEB and commercial Telpak to Mt. Vergine
VAI-NPS	Full-Dux	AUTOVON	9	9	Excellent	Dedicated Link
VAI-RSN	Half-Dux	AUTOVON	29	26	Excellent	
VAI-LDN	Half-Dux	AUTOVON	21	19	Excellent	
HBG-NPS	Half-Dux	AUTOVON	9	7	Good	

Table 1. European Demonstration Test Results (Continued)

Location[1]	Configuration	Transmission Media	Calls		Performance	Comments
			Attempted	Complete		
VAI-MEL	Half-Dux	AUTOVON	17	9	Good	Transatlantic calls had noticeably higher BER (1% - 9%). Terminal at Melbourne was an older version and not properly aligned.
VAI-LDN-MEL	Conference	AUTOVON	3	1	Good	See comment above
VAI-LDN-NPS	Conferencing	AUTOVON	7	5	Excellent	
VAI-HBG	Half-Dux	Ring-down	5	5	Excellent	
VAI-RSN	Half-Dux	Ring-down	4	4	Excellent	
VAI-HBG	Half-Dux	DDD	11	9	Excellent	
VAI-RSN	Half-Dux	DDD	8	0	Poor	Low levels experienced over DDD. If levels were higher link would be useable
VAI-HBG	Half-Dux	Tactical	1	1	Excellent	See Reference 2

Table 1. European Demonstration Test Results (Continued)

Location[1]	Configuration	Transmission Media	Calls		Performance	Comments
			Attempted	Complete		
VAI-HBG	Half-Dux	Tactical	3	0	Poor	Terminals synchronized reliably however error rate was greater than 8%. Problem traced to TD-660 - see report See Reference 3
VAI-HBG	Half-Dux	Tactical	3	0	Poor with field phones - see report	Level problems
VAI-USS Albany	Half-Dux	DSCS	2	2	Excellent See report	Moderate Link instability -
VAI-USS Albany - LDN	Conferencing	DSCS	2	2	Excellent	
VAI-NPS USS Forrestal	Full-Dux	CV3333 Tandem	2	2	Good	
VAI-NPS USS LaSalle	Full-Dux	CV3333 Tandem	1	1	Excellent	

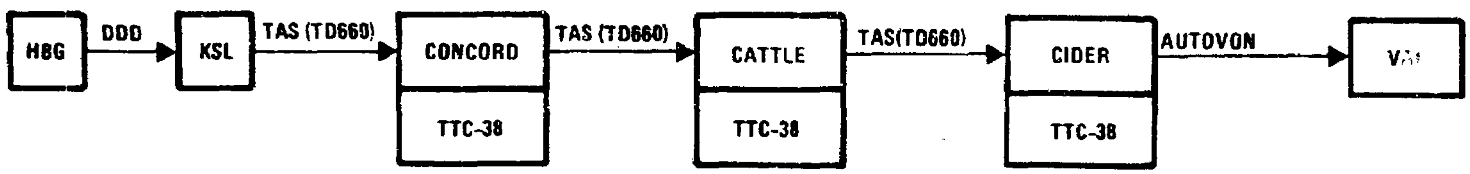
Table 1. European Demonstration Test Results (Continued)

Reference 1.

VAI	=	PATCH BARRACKS
HBG	=	HEIDELBERG
RSN	=	RAMSTEIN
LDN	=	LONDON
NPS	=	NAPLES
MEL	=	HARRIS CORPORATION, MELBOURNE, FL
KSL	=	KARLSHRUE

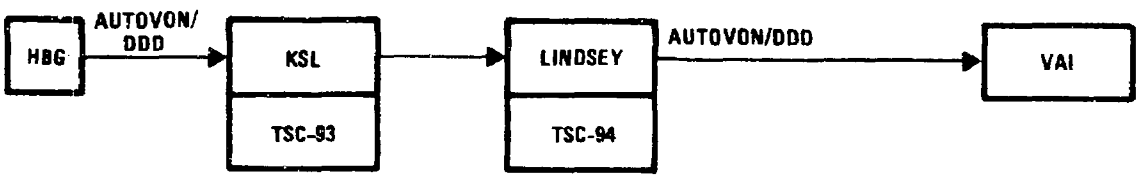
Reference 2.

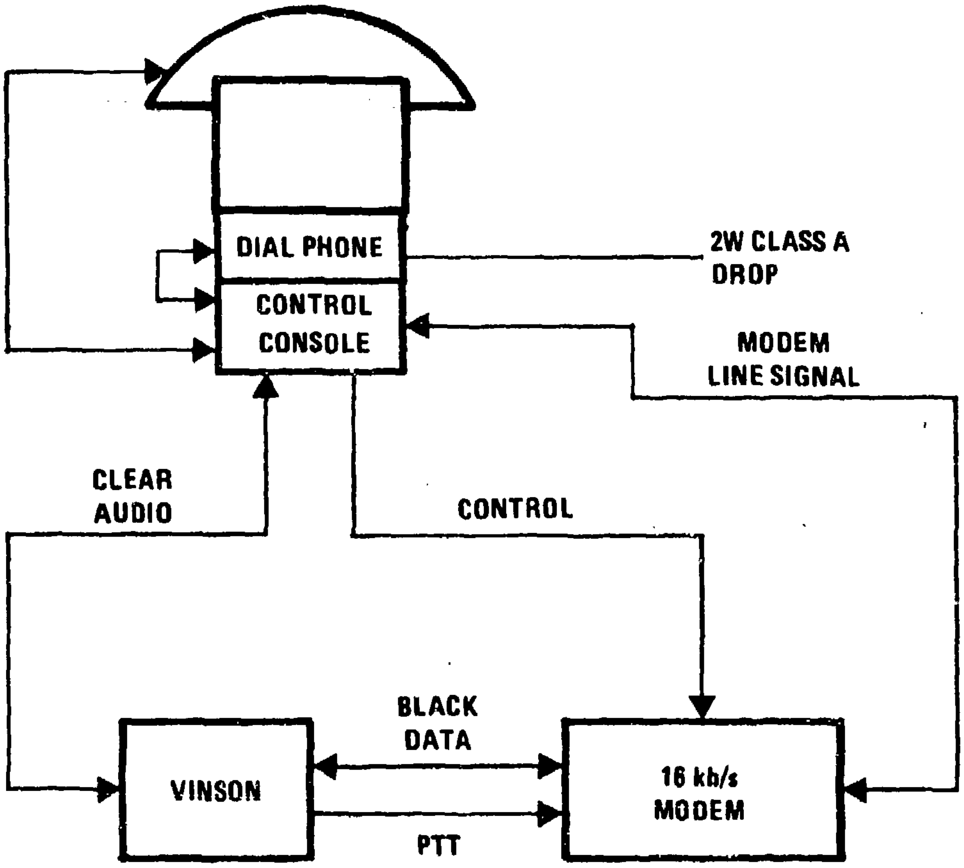
TACTICAL LINK 1



Reference 3.

TACTICAL LINK 2





A90440-21

Figure B.2.1. Heidelberg and Ramstein Single User Terminal Configuration

demonstration, a standard dial phone with class A service was used to place and receive test calls. Three types of circuits were available: AUTOVON, direct dial, and dedicated line (operator assisted).

With the type of installation shown in Figure B.2.1, the telephone line is accessed through the handset port of the telephone instrument. Installation requires only the removal of the existing handset and its replacement with a push-to-talk handset. The handset port in the telephone instrument is then connected to a cord set that terminates in the control head. The telephone set will then operate normally for clear text calls and will also allow secure conversations when a call is placed to or received from a party with similar equipment. When the VINSON/AUTOVON adapter is used on a two-wire circuit as described, operation is limited to a push-to-talk mode. This requires only a limited amount of coordination and is very similar to using a radio link. Four-wire installations will permit full-duplex operation since separate transmit and receive paths are available.

B.2.2 Heidelberg Special Tests

In addition to the test calls placed over AUTOVON, direct dial, or dedicated circuits, two special tests were conducted from Heidelberg. One special test involved interface with two types of field phones; ring down and DTMF. Unfortunately the tactical link was too noisy to permit the ring-down test to succeed although this type of phone circuit should present no problem if the line is interfaced with a relay circuit that will permit the phone to access the line for signalling.

The DTMF phone test revealed an interface problem. The DTMF type field phone uses a dynamic microphone element in the standard handset. The telephone is designed to interface with this element and will not accept a carbon-button mike. In addition, the signal level required by the phone circuitry is much lower than the modem's lowest output level (approximately -45 dBm). The level problem can be easily solved by the insertion of a

30 dB pad at the modem output. The microphone problem can be solved by the use of a dynamic element in the VINSON terminal handset. Both of these problems have been solved since the tests and laboratory tests have been performed to verify that a DTMF field-phone can be successfully interfaced.

Another special test was performed to test the feasibility of using the VINSON equipment with a mobile radio-telephone installation. Results were mixed. The modem would synchronize, but the error rate was too high to permit communication. The interface tested used the radio's handset port and, like the DTMF field phone, level problems exist. In addition, the receiver seemed to have audio AGC which may be nonlinear. Tests have been performed successfully in the laboratory using similar radios. This required special interfaces that bypassed speech compression and AGC circuitry. Further tests will be required to determine if the radio used in this last test will permit VINSON service.

In addition to the phone tests, tactical satellite links were tested. The modem consistently synchronized, but the results were disappointing due to high (3-4 percent) error rates. Further tests were run at Karlshrue to evaluate the problem.

B.2.3 Karlshrue

The tests run at Karlshrue investigated the difficulties encountered with tactical satellite links. Two shots were set up and audio drops were remoted to two phones installed for the tests. Both end-to-end and satellite loop tests were performed with the same results. The error rate was consistently in the 3-4 percent range. Through the use of loop-back tests, the problem was isolated to the TD660 multiplex/PCM equipment. Further testing was done with a TD660 looped directly and located with the modem. Results were consistent. The modem ran approximately at a 3-4 percent error rate. Sine wave tests revealed that the MUX is very sensitive to input level. An input level of -6 dBm gave low distortion

(2nd = 40, 3rd = 32). Dropping the input level to -16 dBm gave readings of: 2nd = 25, 3rd = 35. Since the modem signal is multilevel, this level sensitive distortion causes a high error rate. The modem will, however, run error-free at 8 KB/S, since the 8 KB/S mode uses only one amplitude.

Additional investigations performed after the test program indicated that the TD660 has a narrow linear range due to the compression used. Lowering the levels below the compression range may give increased linearity, but may cause signal-to-noise problems. Equipment alignment may also play an important part in linearity at low levels. This particular problem will require further investigation. Alternate methods of using the tactical satellite links may provide additional approaches. The terminals may be used in digital modes which can support the VINSON equipment directly. In this type of setup the tactical satellite links are used to relay digital signals which are interfaced with the telephone network by repeater modem installations.

B.2.4 Patch Barracks Conference Demonstration

A three-way secure conferencing demonstration was performed during the second week of the test program. The control or hub was located at Patch Barracks and single-user terminals were located at Navy London and Naples. All terminals operated in the half-duplex mode during the conference demonstration.

The equipment setup for the hub location is shown in Figure B.2.4-1. The conferencing scheme used requires one modem for each remote line, a conference bridge, and the VINSON equipment. Since the experimental conference bridge used was digital and the mode half-duplex, only one set of VINSON equipment was needed at the hub location. The conference bridge provided all signals necessary to support the conference keyset, control the two modems, and supply multiplexed data to both the modems and the VINSON equipment. As in the single user terminals, the phone operates normally in

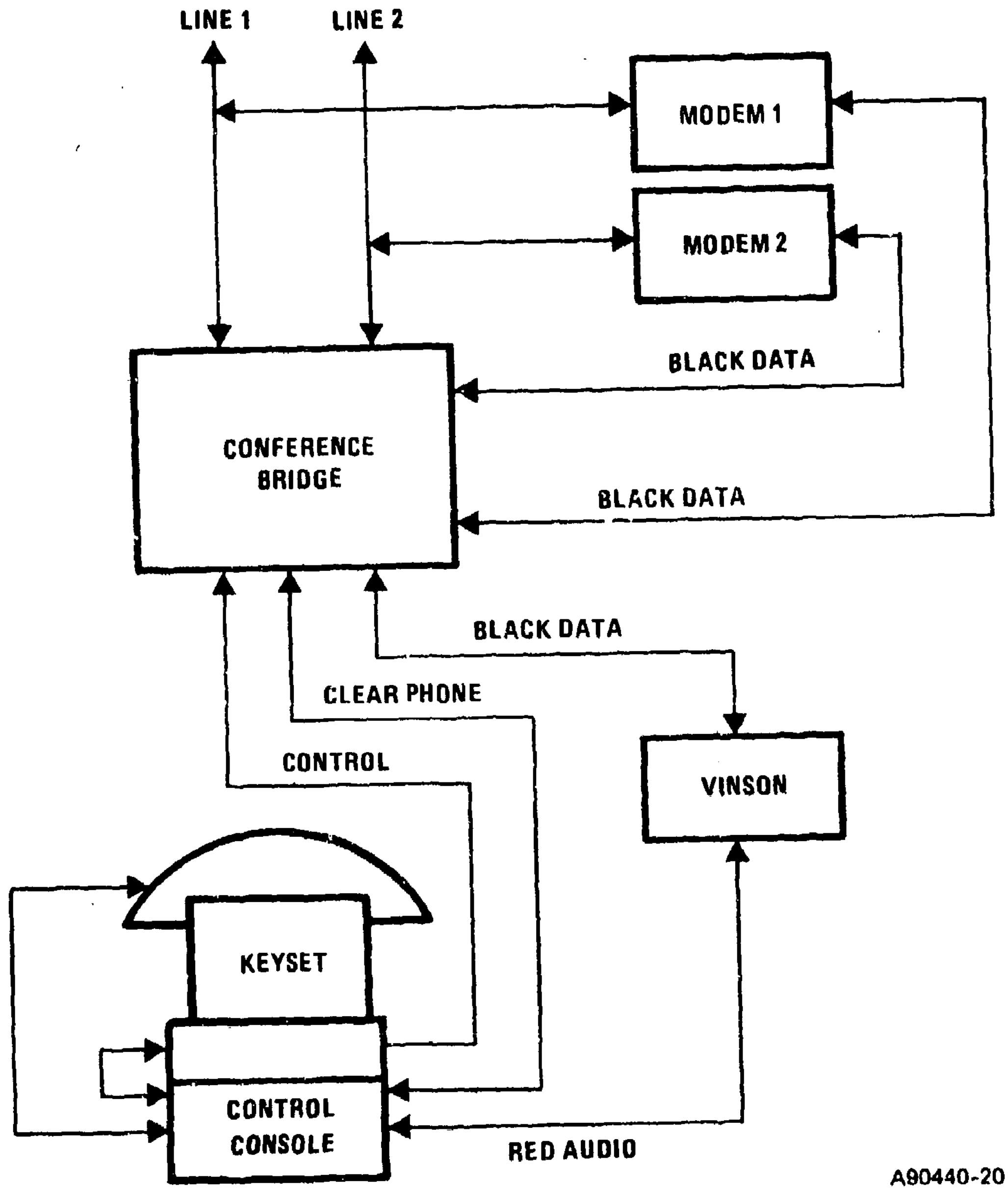


Figure B.2.4-1. Three-Party Conference Hub, Patch Barracks

the clear mode, except the bridge has the capability of holding more than one line at a time. Hold capability exists in both the clear and secure modes. The bridge location also has the capability of placing two-party as well as three-party calls. The conferencing capability is, however, limited to the secure mode since the bridging is digital. No analog bridging capability is provided.

The conference bridge itself had two major functions: 1) to provide clear phone support to permit dialing, answering, and line holding; and 2) to provide bridging functions to allow a three-party secure conference. Figure B.2.4-2 shows the conference bridge in three main functional blocks. The clear phone control provides all line and phone support functions, the digital bridge control provides modem and control functions, and the digital data bridge provides multiplex functions that allow both conferencing and two-party calls. Figures B.2.4-3, -4 and -5 show the functional blocks in more detail. Figure B.2.4-3 shows the clear phone control. Pickup, hold, and call placing are supported by this circuit. The control logic interfaces with the telephone keys and provides the signals necessary for the pickup and hold units to cause the lines to answer and to hold a line once the initial clear call has been made. Holding coils and contact closures that are needed by the phone terminal equipment are provided by the pickup and hold circuitry. Since the phone has only a single receive port, a receive MUX is provided for four-wire operation.

The digital bridge control shown in Figure B.2.4-4 provides control functions to the modems and permits one control console to access both modems. When a line key on the phone is depressed, the control lines and status indicators from the control console are routed to the modem associated with the selected line. Circuitry in the control MUX also allows the input and output data MUXES in the digital bridge to pass data either in the two or three-party modes. The digital bridge is shown in Figure B.2.4-5. The bridge is made up of input and output data multiplexers. The multiplexers are enabled by signals from the control

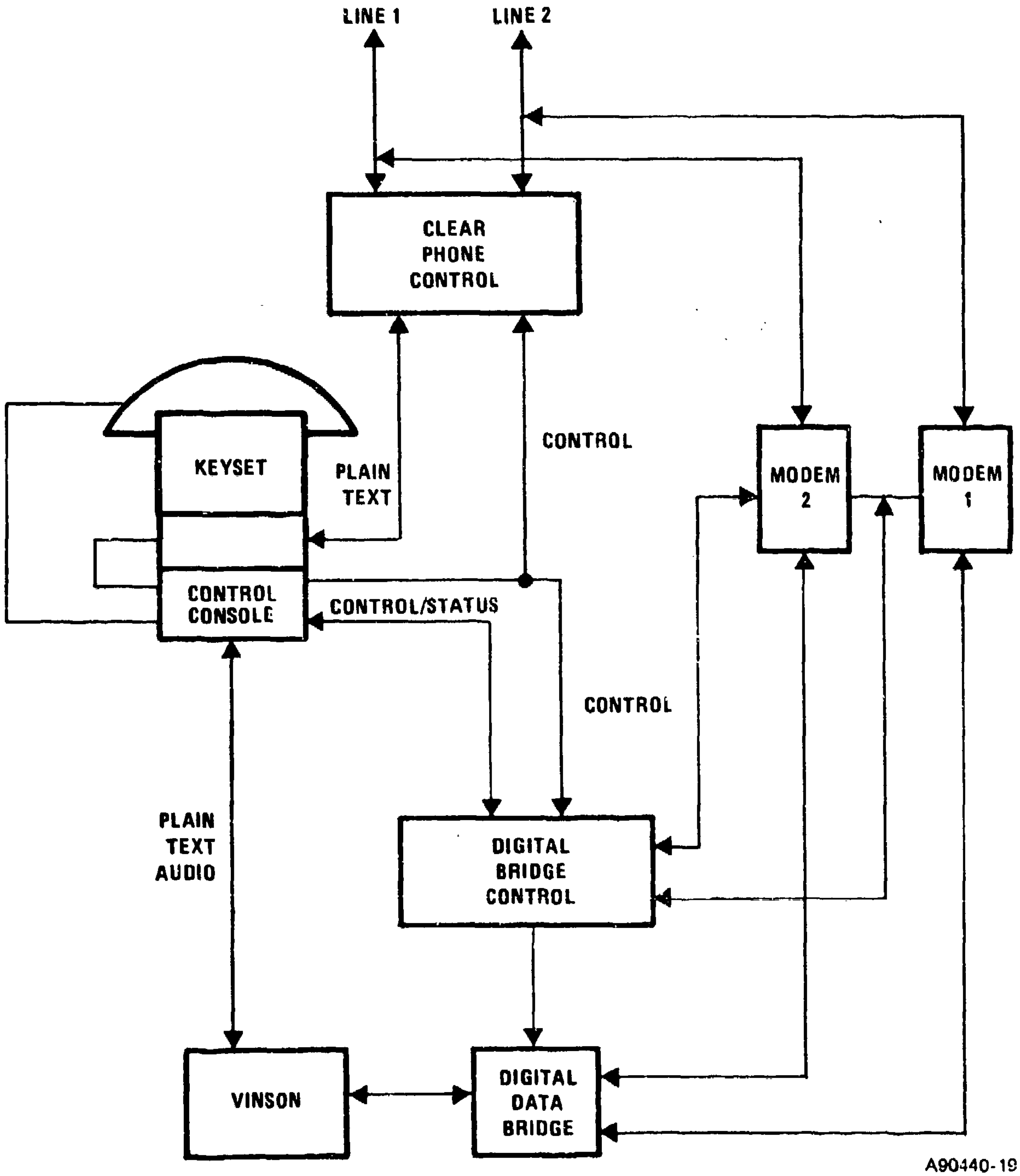


Figure B.2.4-2. Conference Bridge Functional Diagram

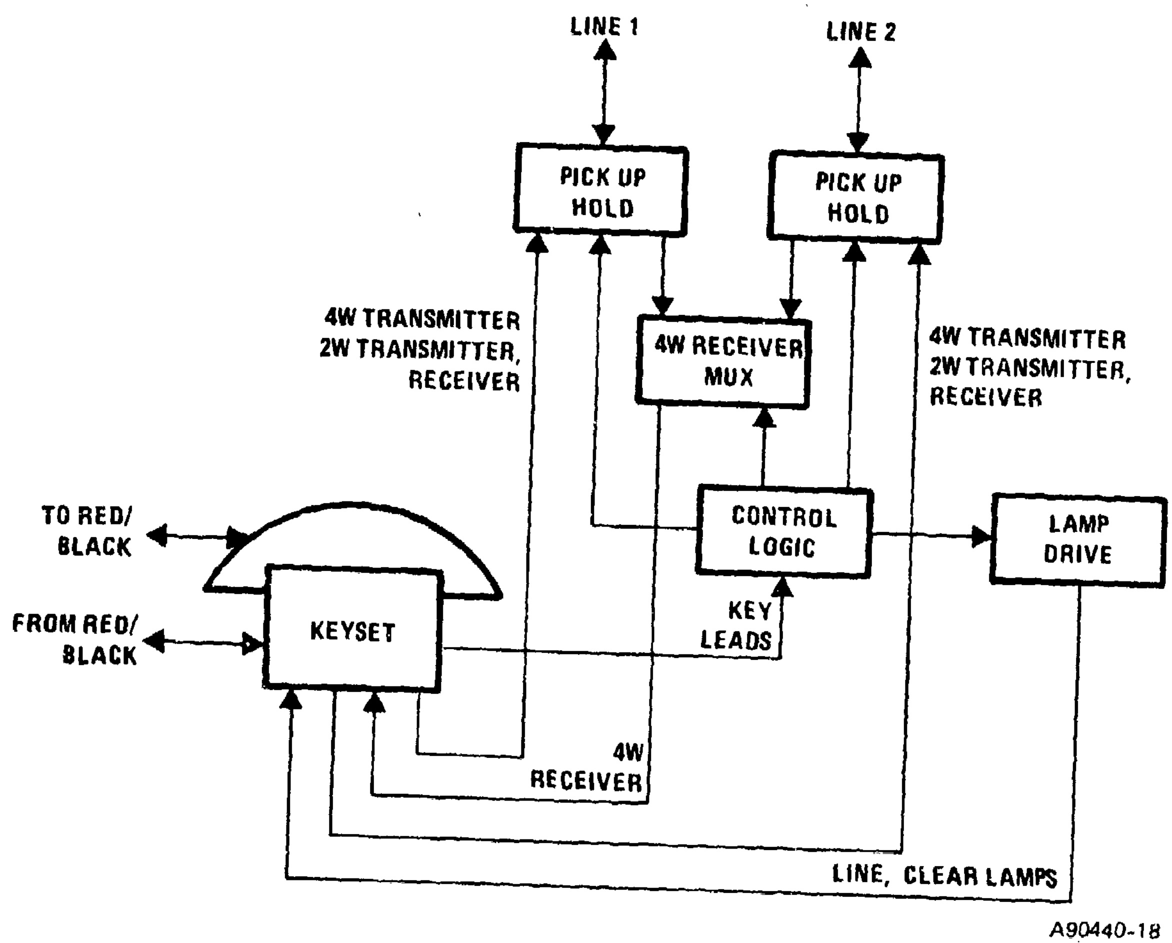


Figure B 2.4-3. Clear Phone Control

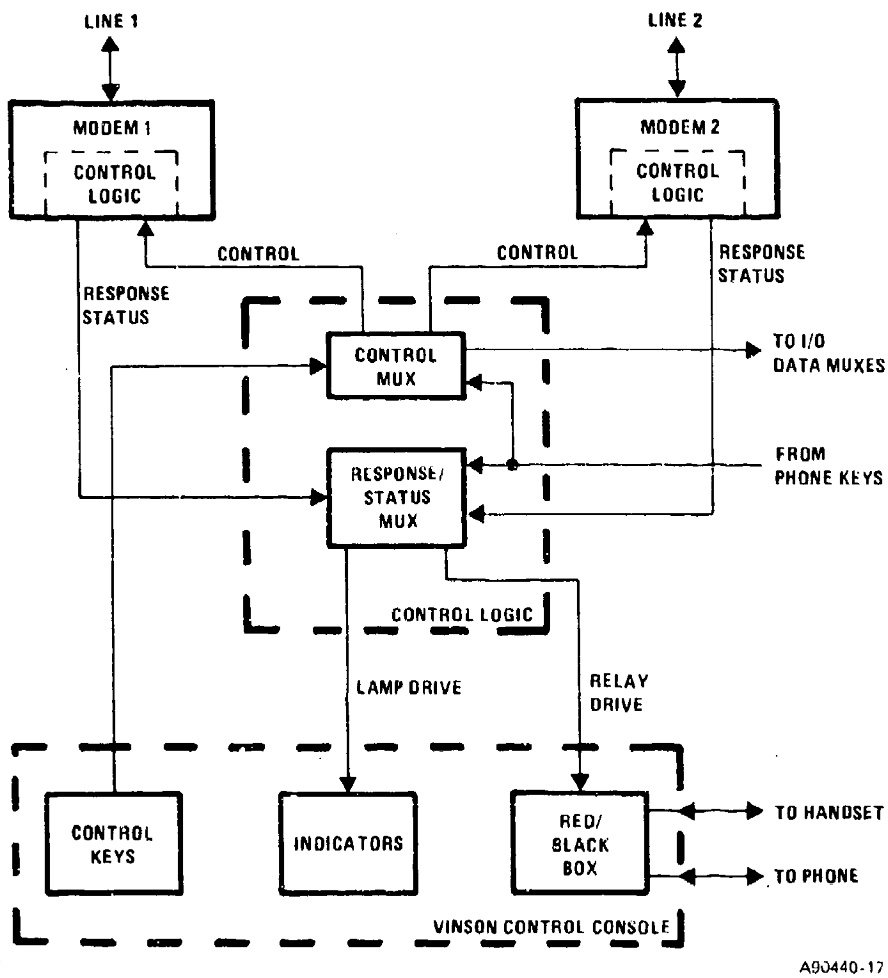


Figure B.2.4-4. Digital Bridge Control

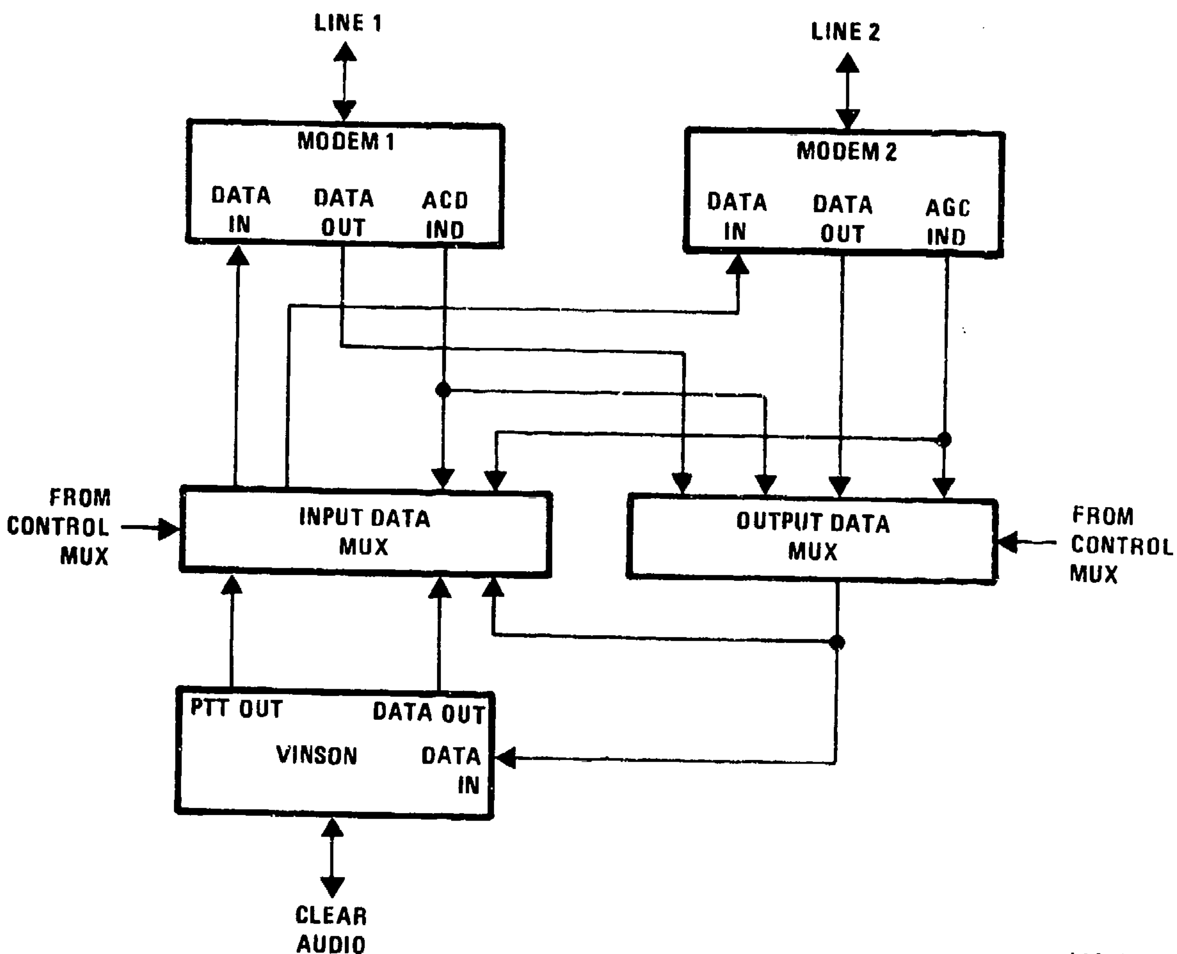


Figure B.2.4-5. Digital Bridge

multiplexer. The input/output MUXES may be locked by selecting only a single line in which case data is routed directly to and from the VINSON. In the confrence mode the multiplexers select the data to be transmitted by each modem. The selection of data is dependent on the AGC indicator lines from each modem and the push-to-talk line from the VINSON. When a modem is receiving, its output data is routed to the other modem's input for transmission over the other (nonreceiving) link. When the VINSON is keyed, its output is fed to both modems, and the VINSON input is selected from each modem output using the same criteria as for retransmission. This scheme permits only half-duplex operation and requires only one of the conference members to act as a net control station. This was found to be a satisfactory method of operation during the conferencing demonstration.

B.3 ITALY DEMONSTRATION

The activity in Italy during the demonstration period was primarily a support role to the focal or hub point of the effort in Germany. However, significant narrowband in tandem was successfully demonstrated.

Tests were run from NAVCAMSMED near Naples, and the USS Albany (Sixth Fleet command ship) at the dock in Gaeta (60 miles north of Naples).

At NAVCAMSMED two types of telephone lines were used:

a. A four-wire AUTOVON line, normally used by the Tech Control personnel. All AUTOVON dial trunks to Germany and England pass through the Tropo link T0055 between Coltano and Mount Limbara on Sardinia.

b. A point-to-point (ring-down) line set up specifically to support this demonstration. This line traversed the leased Italian Telpak between Coltano and Mount Vergine (near Naples) and thus avoided T0055. This line was routed from Naples to Mt Vergine, via Telpak to Coltano, over the Digital European Backbone (DEB) to Hohenstadt, to Patch Barracks, thus avoiding T0055.

Calls using T0055 were variable from day to day and within the same day. At times, clear conversation was almost impossible because the tropo fades were so numerous and deep. At other times the link was satisfactory, although the fades were always noticeable.

Terminal performance reflected this variability. On most days, when the channel was relatively poor, the bit error rate averaged about 5 percent and the secure link was only marginally useable. On good days the BER varied from 0.5 to 1.0 percent and the secure link was good. On one occasion a BER of 0.02 percent was observed.

The problem lay primarily in T0055 by setting up a loop to Mount Limbara. This traversed T0056 between Mount Vergine and Mount Limbara twice, rather than T0055 in tandem with T0056. (T0056 is actually a longer tropo shot than T0055.) The BER on this loop was approximately 1 percent on a day when the tandem exhibited a 7 percent BER.

The dedicated line via Telpak/DEB was consistently good, yielding bit error rates of about 0.03 percent.

Analog tandem tests with CV333 Vocoders were also run at NAVACAMSMED. This was done at the Secure Voice Console where operational interconnection between UHF SATCOM secure voice to ships and AUTOSEVCOM land lines is performed. The VINSON audio was connected to test points on a spare channel and switched to CV333 audio using the console. Telephone connectivity was established using the same dedicated line described above. Tests were run on two separate days to several ships including the USS Albany and USS LaSalle. On all calls both ends of the link reported that the voice was loud and clear.

With this same setup two additional tests were run. One test used the CV3333 link on the TDM (Time Division Multiplex) SHF satellite link to the USS Albany. After multiplexing with digital data and teletype, this

link is spread using the same URC-61 used in analog tests on the SHF satellite. The second test was a tandem demonstration with a wideband (50 KB/S) subscriber from the secure voice console. Both tests were successful with both ends reporting good voice quality.

The final tests were spread spectrum SHF satellite tests between the USS Albany and the Army earth station at Landstuhl, Germany. This link is normally operated in a digital, 4800 b/s configuration between the ship and the earth station at Lago di Patri near Naples. For these tests the URC-61 was operated in an analog mode in which the analog signal frequency modulates a square wave oscillator, which is mod-2 added to the spread sequence. With the VINSON terminal this configuration achieved a BER of 0.5 percent toward the Albany and 1 percent toward Germany with good voice quality. Had more time been available, this performance might have been improved with more optimized deviations and RF power levels. The configuration required 2 days to become operational. This was attributed to the unfamiliar analog operating mode, different earth station, and communication coordination difficulties between the two terminals.

B.4 UNITED KINGDOM DEMONSTRATION

Like Italy, the activity in the United Kingdom was limited to that of a support role to the main demonstration effort at Patch Barracks. The terminal was connected in a two-wire configuration at Navy London (USNAVEUR) for the second week of the demonstration program. The test results are provided in paragraph B.1.1.

APPENDIX C

GALLANT EAGLE OPERATIONAL EXERCISE

C.1 INTRODUCTION

Four developmental VINSON/AUTOVON Adapter secure voice terminals were provided for evaluation during the joint exercise known as Gallant Eagle 80. These terminals provided secure point-to-point and conferencing capability over the existing voice-frequency (narrowband) telephone network. The purpose of the test was to demonstrate these capabilities in a field exercise environment, and determine any modifications required for this application.

The results were very satisfactory. Secure communication was established in most cases where nonsecure communication was possible. Most users rated the voice quality from good to excellent. Operational useage was high, and there were many repeat users, indicating satisfaction with the service. Conference calls were satisfactory, although it was apparent that for larger conferences full-duplex operation would be more convenient than the half-duplex operation demonstrated. In the tactical environment, full-duplex operation is not difficult to provide, and this service is recommended.

C.2 DESCRIPTION OF TERMINALS

This section provides a brief functional description of the terminals.

C.2.1 Basic Terminal

The terminals consist of the following components:

- KY-58 VINSON Comsec Unit
- A Rome Air Development Center/Harris Corporation 16 KB/S Wireline Modem

- Control Box and Switching Unit

The KY-58 performs (in the transmit mode) the analog-to-digital conversion of the voice signal using the CVSD (Continuously Variable Slope Delta Modulation) algorithm, and the security encryption of resulting digital data. The KY-58 output is 16 KB/S encrypted digital baseband data.

In the receive mode, the converse operations of decryption and digital-to-analog conversion are performed.

The modem transmitter provides the conversion between the digital data and a quasi-analog signal which will pass through the narrowband voice-frequency telephone system. The modem receiver accepts the quasi-analog line signal and processes it to produce the digital baseband signal for the KY-58.

The control box and switching unit allow placing or accepting telephone calls in the clear mode and switching to the secure mode with automatic modem and crypto synchronization.

The modem is capable of full-duplex operation (on four-wire lines) or half-duplex operation. The KY-58 is a half-duplex device; for full-duplex operation, a second KY-58 is installed in the terminal.

C.2.2 Conference Bridge

A prototype three-part conference bridge was provided for one location. This bridge was developed for applications with only two-wire service operating on a half-duplex, push-to-talk basis. The bridge switching is performed on BLACK digital lines (i.e., between the KY-58 and the modem), allowing the bridge to be an all BLACK device. The bridge also includes the controls for dialing up one line and holding it (in either

clear or secure mode) while the second line is dialed. Once both lines are up and secure a conference button is pressed to connect the local handset to both remote parties.

C.3 TERMINAL LOCATIONS AND INSTALLATION DETAILS

For this exercise, terminals were installed at the following locations:

- Joint Operations Center (JOC), Fort Irwin
- AFFOR (TACC), George AFB
- ARFOR Battle Room Shelter

The JOC location was the conference bridge site. This configuration includes two modems but only one KY-58. Conference calls require both modems and the two associated telephone lines with single party calls utilizing either line. Both telephone lines were two-wire DTMF (Dual Tone Multifrequency signalling) dropped off the TTC-38 Silver Switch.

The AFFOR installation utilized a four-wire drop (and a TA 341 telephone instrument) off the AFFOR TTC-30 switch.

The ARFOR terminal was installed as a remote four-wire TA 341 drop off the TTC-38 Silver Switch. To accommodate the conference bridge both the AFFOR and ARFOR terminals were operated half duplex.

C.4 RESULTS

The section discusses the results of the various tests and demonstrations performed.

C.4.1 Point-to-Point (Two-Party) Calls

The following is a summary of the number of logged two-party calls. It should be noted that number of other calls (particularly on 6 March) were not logged.

Date	Number of Logged Calls
6 March	4 (Plus at least six calls before log was started)
7 March	29
8 March	15
9 March	12
10 March	15
11 March	4 (AFFOR link down for extended period for communication realism)
12 March	7 (Silver Switch down for communication realism 0900-1500)
13 March	2 (Phase out at 1100)
TOTAL	88

Many of these calls were placed by the using parties and did not require any assistance by support personnel. Only a few minor problems were encountered on these calls, and were attributable to radio or switch problems which also affected nonsecure communications. It is estimated that successful secure communications were achieved on at least 95 percent of calls attempted. Voice quality was rated from good to excellent on most of these calls.

C.4.2 Conference Calls

Three-party conference calls were placed on 7 and 8 March with all participants expressing satisfaction with the demonstrations.

C.4.3 8 KB/S Tests

Both the modems and the KY-58's have an 8 KB/S mode in addition to the normal 16 KB/S mode. A few channels are encountered where the bit error rate at 16 KB/S results is objectionable audio noise or causes the KY-58 to squelch. On these channels the bit error rate at 8 KB/S is usually very low. Tests were run to evaluate the voice quality of the terminals operating at 8 KB/S. This was done on both two-party calls and three-party conference calls. The conclusion was that the voice quality, although not as good as 16 KB/S, was quite intelligible and satisfactory for tactical applications. On channels where the 16 KB/S bit error rate was high, voice quality was judged at better than 8 KB/S.

C.4.4 Satellite Tests

Tests were run through the TSC-85 satellite terminal at Fort Irwin and the TSC-92 at MARFOR. This was accomplished by calling the MARFOR operator from the ARFOR terminal and asking for the JOC terminal drop. Note that this involved two satellite hops in tandem, one to MARFOR and one return. On this setup, synchronization was successful only 50 percent of the time, and 16 KB/S bit error rates were 3 percent, resulting in noisy audio. At 8 KB/S the bit error rate was low and voice quality was satisfactory.

The synchronization difficulties are attributed to delayed echos on the satellite link. A minor modification to the modem has solved similar problems in the past, but was not implemented in these terminals. It is believed that this modification would eliminate the synchronization

problem. It is also possible that the echo was a result of the dial-through configuration and would not be present on a single hop.

A further test was run by dialing the MARFOR switch from the JOC terminal and asking for the AFFOR terminal. This also resulted in tandem satellite links and gave the same results.

C.4.5 AUTOVON Calls

AUTOVON calls were placed from the JOC terminal to the MacDill AFB SECORD where another VINSON/AUTOVON Adapter terminal was located. The modems were successfully synchronized but secure communications were not achieved. It was later established that this was due to different keys in the KY-58's. The successful modem synchronization showed the feasibility of secure voice back to REDCOM via the AUTOVON.

C.5 DISCUSSION AND RECOMMENDATIONS

This section discusses several problems encountered and recommends improvements.

C.5.1 Equipment Grounding

C.5.1.1 Discussion

All three sites experienced various problems due to missing or inadequate grounds. Difficulties with other equipment were also observed due to this problem.

C.5.1.2 Recommendation

On future exercises the quality of the ground should be checked at installation of any communications equipment. It is felt this would reduce the number of intermittent communications problems encountered.

C.5.2 Satellite Tests

C.5.2.1 Discussion

As described in Section C.4, two problems were encountered on the SHF satellite links. One problem was a synchronization difficulty caused by signal reflections. This may not exist on normal links involving an operator dial-through and should be resolved by a terminal modification. The second problem, which had been experienced previously, was high bit error rate at 16 KB/S necessitating operation at 8 KB/S. This was believed to be due to high distortion in the TD 660 PCM multiplexers used in the satellite terminals. It is possible that careful adjustment of the TD 660's would improve 16 KB/S operation, but has not been investigated.

C.5.2.2 Recommendation

1. A satellite loop be set up with AUTOVON connectivity. This would allow investigation of the synchronization problem from AUTOVON lines in the Harris Corporation facility in Melbourne, Florida.

2. A pair of TD 660's (and maintenance manual) be made available to Harris Corporation to investigate the feasibility of adjusting them to achieve 16 KB/S operation.

C.5.3 Full-Duplex Conferencing

C.5.3.1 Discussion

Operational use has shown that, while the half-duplex conference is satisfactory for small (three-party) conferences with experienced users, larger conferences would funcion more smoothly in a full-duplex mode. In the tactical environment, four-wire telephone service is readily available and a full-duplex conference could be supported. The conference setup and control logic of the existing bridge could be used. A better approach, if feasible, would be to have the switch operator control the conference setup.

C.5.3.2 Recommendation

Further consideration of a full-duplex conference set up by the telephone operator.

C.5.4 Terminal Operational Useage

C.5.4.1 Discussion

The use of the terminals for operational secure voice traffic was high considering the very limited number of terminals deployed and the inconvenience of their physical location. The user preference of VINSON terminals over PARKHILL was noticeable. The PARKHILL terminal at the JOC was adjacent to the VINSON and observed use was less in spite of the larger number of PARKHILL terminals deployed.

C.5.4.2 Recommendation

The degree of use should be considered as documented evidence of a verified need for improved secure voice service.

APPENDIX D

HORIZON SOUTH-80 DEMONSTRATION

D.1 INTRODUCTION

This Appendix discusses the demonstration of the VINSON/AUTOVON adapter at the AFSC Commander's Conference (Horizon South-80). The demonstration took place during the period 12-16 May 80. The objective of this demonstration was to prove that classified briefings can be remotely presented from an AFSC product division/laboratory to an AFSC command location. The benefit associated with this capability is reduced travel requirements and reduced travel costs. The briefing was presented from RADC, Griffiss AFB NY to Homestead AFB, FL.

D.2 HORIZON SOUTH-80 DEMONSTRATION DETAILS

The equipment was installed in the audio room of the USAF Conference Center and interfaced with the existing conference room sound system. The sound system consisted of two speakers located in front of the conference room (each side of the screen) and 35 microphones to service the large number of conferees. At RADC, the equipment was interfaced with a standard telephone handset and a single speaker, all located in RADC's Digital Communications Experimental Facility (DICEF). At each location, the equipment was installed on a normal 4-wire AUTOVON telephone. The Homestead AUTOVON telephone had an immediate precedence capability to minimize the possibility of preemption during the demonstration. Once the equipment was installed and operated over the sound systems at RADC and Homestead, it was readily apparent that the quality of the voice transmission over the system was highly dependent on the quality of the conference room sound systems. With open microphones and speakers at each location, the effect of feedback became an acute problem

which required careful alignment of the sound systems. In order to minimize the feedback, many of the floor mikes had to be turned off. In addition, a sidetone disable switch had to be added to the VINSON cabinet.

On 14 May 80, the harddcopy of briefing viewgraphs were transmitted over the VINSON/AUTOVON Adapter using a QWIP facsimile machine (made by EXXON). The quality was excellent considering that an error rate of approximately 1% was being experienced. The fax machine was run in the 4 minute mode.

The briefing was presented to General Slay (AFSC/CC) and his commanders on the morning of 16 May 80 using the viewgraphs made from the fax material. The demonstration went very smoothly, the voice quality was excellent, and the conferees were pleased and impressed with the remote classified briefing demonstration.

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DEPARTMENT OF THE AIR FORCE
AIR FORCE RESEARCH LABORATORY (AFMC)

1 Jun 04

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FROM: AFRL/IFOIP

SUBJECT: Distribution Statement Change

1. The following documents have been reviewed and have been approved for Public Release; Distribution Unlimited:

ADB084552, "Project Birdwatch at Dover AFB", RADC-TR-84-7

ADB191869, "Acousto-Optic Beam Steering Study", RL-TR-94-121

AD0800669, "Use of Commercial Broadcast Facilities for Emergency DoD Communications", RADC-TR-66-392

ADB058979, "Multi-Rate Secure Processor Terminal Architecture Study", RADC-TR-81-77, Vol 1.

ADB053656, "16 KB/S Modem (AN/GCS-38) CONUS Test", RADC-TR-80-89

ADB055136, "VINSON/AUTOVON Interface Applique for the Modem, Digital Data, AN/GCS-8", RADC-TR-80-341

ADB043556, "16 KB/S Data Modem Partitioning", RADC-TR-79-278

ADB029131, "16 Kilobit Modem Evaluation", RADC-TR-78-127.

2. Please contact the undersigned should you have any questions regarding this document. Thank you very much for your time and attention to this matter.

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